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# Enhanced Laboratory Learning

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Innovation, in the field of information sharing, has the potential to increase the educational value of material through more convenient and easy to use formats. This project sought to implement an informational database using the Web 2.0 wiki technology that will serve to improve student comprehension of Biology Lab material and procedures. The collected results showed that the wiki generally improved the ability of the students to comprehend and access necessary material. Related areas of study for future project ideas could include activating the option to allow all users the ability to edit pages, creating a peer edited informational database.

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# Introduction

Collegiate biology lab courses, even those of the lowest levels, require a working knowledge of laboratory equipment that many students may not yet possess. This can create a steep learning curve as students attempt to learn new laboratory techniques while still completing labs in a time effective manner. Previously at WPI, instructional videos were created that demonstrated many, possibly unfamiliar, lab techniques commonly used in WPI lab sessions. While helpful, the videos were presented in an unorganized, incomplete list separate from the pre-labs and procedures relevant to each week's lab.

The goal of this project was to give structure to the information resources available to all biology lab students. The current method for posting the information provided for students is through the use of the MyWPI website hosted through Blackboard. The functions of Blackboard allow professors to post class materials in documents, such as a syllabus, homework, and lab handouts, using a pre-made format that students can access after logging in. To improve upon this format, a wiki site was created that contains all of the necessary course material for the WPI 2000 level biology lab courses, which include documents such as lab procedures and laboratory safety rules. For this project, additional supplementary material was created specifically for the BB2903 Anatomy and Physiology Lab, which will serve as the experimental time period. The appeal of the wiki design lies in the ability of individual pages to be viewed without the need to download a document to your computer, allowing for easier access. The wiki also contains an internal search function that can be used to allow for a more expedient experience while navigating the provided material. In addition to the improved functionality, supplemental information for defining key concepts can be added to improve upon the existing database available to students in order to eliminate the need of external sources. We believe that these improved qualities will help increase student comprehension throughout their participation in the biology lab courses.

In order to fully understand the impact that technology has on classroom education it is important to first become aware of different styles or methods of teaching. In order to employ the best method, it is necessary to first discover what the final result of the learning is intended to be (Bourner, 1997). Bourner developed a general range of intended outcomes for higher education learning and they are listed as follows, "1. Disseminate up-to-date knowledge, 2. Develop the capability to use ideas and information, 3. Develop the student's ability to test ideas and evidence, 4. Develop the student's ability to generate ideas and evidence, 5. Facilitate the personal development of students, 6. Develop the capacity of students to plan and manage own learning." There are many different teaching methods that can be used to reach any of these learning outcomes. Bourner created a chart (Figure 1) that gives a list of methods for each of the different desirable outcomes for learning. They include, but are not limited to, lectures (in class experience), using the internet, computer based simulations, and presentations (Bourner, 1997).

**Figure 1. (Bourner, 1997)**

**Table I** Teaching and learning methods for different learning aims

| | Learning aims | | | | | |
|---|---|---|---|---|---|---|
| | Disseminate up-to-date knowledge | Develop the capability to use ideas and information | Develop the student's ability to test ideas and evidence | Develop the student's ability to generate ideas and evidence | Facilitate the personal development of students | Develop the capacity of students to plan and manage own learning |
| Ten common teaching methods | 1. Lectures<br>2. Up-to-date textbooks<br>3. Reading lists<br>4. Hand-outs<br>5. "Guest" lectures<br>6. Use of exercises that require students to find up-to-date knowledge<br>7. Develop skills in using library and other learning resources<br>8. Directed private study<br>9. Open learning materials<br>10. Use of the Internet | 1. Case studies<br>2. Practicals<br>3. Work experience<br>4. Projects<br>5. Demonstrations<br>6. Group working<br>7. Simulations (e.g. computer based)<br>8. Problem-solving<br>9. Discussion and debate<br>10. Essay-writing | 1. Seminar and tutorials<br>2. Supervision<br>3. Presentations<br>4. Essays<br>5. Feedback on written work<br>6. Literature reviewing<br>7. Exam papers<br>8. Critical assessment<br>9. Peer assessment<br>10. Self-assessment | 1. Research Projects<br>2. Workshops on techniques of creative problem solving<br>3. Group working<br>4. Action learning<br>5. Lateral thinking<br>6. Brainstorming<br>7. Mind-mapping<br>8. Creative visualization<br>9. Use of relaxation techniques<br>10. Problem solving | 1. Feedback<br>2. Action learning<br>3. Learning contracts<br>4. Role play<br>5. Experiential learning<br>6. Learning logs<br>7. Structured experiences in groups<br>8. Reflective documents<br>9. Self-assessment<br>10. Profiling | 1. Learning contracts<br>2. Projects<br>3. Action Learning<br>4. Workshops<br>5. Mentors<br>6. Reflective logs and diaries<br>7. Independent study<br>8. Dissertations<br>9. Work placement<br>10. Portfolio development |

The point of using technology in the classroom is to create a learning environment where the students understand and can interact. Recent advancements in the domain of electronic communication, information sharing, and computer applications (hereafter referred to as technology) have expanded the possibilities for effective supplements in collegiate level learning environments. Computers are such an important part of the average college students' daily life that including them in the classroom can be considered more of a necessity than an option. There are many studies describing the effects of different kinds of technology used in the classroom.

As improvements in technology are made, applications of technology become more extensive. Educational technology is the use of technology in teaching and learning. The tools used in education should "enable students to stimulate, visualize, model and experiment with complex, real-world scientific problems" (Ranjan, 2008). Technological advances, like wikis, which allow greater information sharing, can give educational institutions a competitive edge (Ranjan, 2008).

One study in 2008 introduced Tablet PC's and probeware (scientific equipment that can record data and display it on a computer) into a high school biology laboratory class in order to test whether the PC's would improve student learning (Pryor, 2008). The results of the study showed that while student performance did not improve significantly, those students who used the PC's and the accompanying probeware gained valuable skills in laboratory data collection that are similar to the methods used in research facilities today. In addition, the quality in both data analysis and presentation of the student's lab reports was much improved over those written by the control group of students who did not use the PCs (Pryor, 2008).

In another study (Carle, 2009), a discussion based college class was split into a control and experimental group. The experimental group discussions were recorded using iPod technology and later reviewed using the popular music program iTunes by the class professor, who could then give feedback to the group. At the end of the course, students in the experimental group had consistently scored an average of 20 percent higher on homework and tests than those in the control group. When surveyed, the experimental group also expressed much higher enthusiasm for the course (Carle, 2009).

Improving classroom communication is another benefit of using technology. Student response systems, also known as clickers, are an interactive technology that is designed to help fulfill the increase in demand for student centered learning. This is achieved through the use of a program that is designed to operate in conjunction with the clickers. After training, professors are able to design a course program that will pose questions relating to lecture material. The benefits of this can actually be seen from both sides of the spectrum. For the students the clickers act as reinforcement for lecture material as they are provided with answers for questions that the professor feels are important enough to get a classroom wide response. Professors benefit from the clicker system as well, because the responses that the lecture hall sends gives the professor immediate feedback on how well the class understands the concept that was presented in the question. The clicker experience is just one example of many that show that technology is greatly improving the methods of teaching, in this case by increasing the interactivity and student teacher communication during lectures, keeping students more immersed in the information being transferred and increasing retention (Weerts, 2009).

Another technology that can be considered beneficial to student education in the classroom is interactive whiteboards, which are becoming more common in academic settings across the country. Interactive whiteboards were originally introduced for use in business but caught on in higher education. Many studies show that use of technology is beneficial to students, although there is not sufficient information to suggest that interactive whiteboards are a specific technology that creates success in the classroom. Some benefits of using interactive whiteboards are: "meeting the needs of visual learners, more interactively teaching whole-class lessons, better engaging the students, and using a variety of multimedia within the class lesson" (Lacina, 2009). One down side to digital whiteboards is thought to be that students become spectators instead of critical thinkers, because students can only interact one-on-one with the

interactive whiteboard (the class cannot interact as a whole or all students at the same time) (Lacina, 2009). The cost of this technology is its major drawback. Prices can range from $800-2,500 for the whiteboard and between $450-1,500 for the LCD projector. Studies show that at first, students are motivated by interactive whiteboards, but that enthusiasm is short-lived. In the 2004/2005 school year, a statistical analysis of 30 schools showed that there was no increase in success in the core subjects (Lacina, 2009).

Each of these technological additions contributes to increasing classroom performance in one way or another, but they are so widespread that one study could not cover them all. Our study will focus on the use of wikis to improve the availability and volume of relevant data in a biology laboratory class setting.

The Internet has recently undergone key changes with the addition of new technologies. Specifically, these changes focus on information sharing through the ability of many people to pool their knowledge and communicate with one another. Examples of this include blogs, wikis and hosted servers. A wiki is a series of pages created by a "collaborative effort" (Cronin, 2009). These pages are designed to allow editing by as many users as possible. The pages are written collectively and because editing is allowed by anyone, for a traditional wiki, mistakes are easy to correct. Successful wikis have a core group of users and a large group of occasional contributors (Quiggin, 2006). One of the most commonly known and used wikis is Wikipedia. Wikis are becoming more widespread and it was said that half of the companies in the United States will have their own wikis by the end of 2009(Cronin, 2009). After surveying 168 companies, Majchrzak, Wagner and Yates found that wikis are not a short-term trend. This is in part due to the fact that there are many applications of a wiki (Cronin, 2009).

One of the major applications of a wiki is in education. MediaWiki has been used on multiple academic levels. For example, Bruns and Humphreys (Bruns, 2005) used this program to make a public encyclopedia of new media technologies. The usefulness of a wiki in the classroom was tested in this article. To do this, 25 undergraduate marketing students took on a semester-long project to write a textbook using a wiki instead of using a traditional textbook. About 40% of college students are visual learners and a textbook in a wiki form should be preferable to these students. A wiki is ideal for marketing because marketing is always changing and a wiki can be edited as soon as a change occurs. This makes a wiki more up-to-date then a textbook (Cronin, 2009).

At the start of the class, a survey was given to see how much experience the students had with wikis. It was found that some students had used Wikipedia and the rest had never heard of a wiki. For the project, students would submit wiki pages and edit other students' pages each week. The results showed that students edited pages more often as the class progressed. It was observed that some students enjoyed 'hacking' pages rather than editing them. However, it was clear that the class's knowledge on wikis increased. It was uncertain if the wiki aided in the

students' knowledge about marketing. The learning style of each student was a determining factor in how much the students learned from the wiki vs. a textbook (Cronin, 2009).

At the Oxford Brookes University in England the web 2.0 wiki technology was used to aid in a Japanese Language course, primarily to facilitate group projects (Ramanau, 2009). Through student interviews it was found that the wiki, though initially difficult to use due to varying levels of competency with the technology, improved understanding of the material because it was created by peers rather than a text book (Ramanau, 2009). Wikis are invariably hosted through the use of the internet, but the specific format can vary greatly. Examples of free wiki creation tools include Mediawiki, TikiWiki, and DocuWiki. Other software and programs can be used to create wikis including Microsoft Sharepoint, a server system that can host a wiki as well as provide many other benefits (Ramanau, 2009).

A case study at the University of Houston-Clear Lake, in which the students in a college level language arts class created and maintained a wiki, found that the wiki creation process required the students to have a deeper understanding of the material and gave them a greater sense of investment in the class. Students were required to turn in reflections and written descriptions of their experiences with the creation of the wiki. Many found that the wiki was useful for both personal and professional use, as it increased their understanding of the material that they were researching as well as being applicable in other classes they were taking. This was especially true for the students planning on continuing in education fields. One student noted that looking at the wiki was like having all the useful part of her myriad textbooks compiled in one organized place, allowing for easy referencing. Most of the students reported that the wiki helped a great deal while they were studying for class tests, and those who were in internships with elementary school classrooms commonly utilized activities and explanations from the wiki at their jobs (Matthew, 2009).

In an article by Ferris and Wilder (2006), they claim that wikis are becoming a perfect link between the early agrarian learning methods of oral teaching and the more recent literacy based teaching methods that came into favor after the Industrial Revolution. They argue that the oral teaching method fosters "empathetic focus, grounding in the observable and immediate world, and communal ownership of knowledge", while the literacy based methods emphasize knowledge preservation as well as abstract and analytical thinking (Ferris, 2006). By combining the two in the form of a literary based, communally owned and modified store of knowledge and learning such as a wiki, a new method of teaching can be used, first introduced as 'secondary orality' by W. J. Ong in his book *Orality and Literacy*. Students using the wikis will have access to a large base of knowledge, just as they do with textbooks today, while at the same time being able to comment, share ideas, and collaborate outside the classroom. Detractors of wiki based learning commonly point out that the ease with which information can be changed on a wiki can lead to falsified information that would not be encountered in textbooks (Ferris, 2006). For this reason, our project is focusing on providing information and media through a wiki, while leaving the majority of the community aspect absent.

Sharepoint was chosen as the medium to display the wiki site for our project because it was able to provide all the tools that were required for optimal performance. One study conducted in 2007 compared the benefits of creating a "collaborative online work space" from the ground up using a company team of programmers and database specialists versus using Microsoft Sharepoint as their platform. The company found Sharepoint a more favorable option because it was able to provide everything they wanted such as password protected membership, file upload and storage areas, discussion forums, and member lists. The Sharepoint software was also much cheaper and had a shorter installation and setup time (Zachry, 2007). The previously mentioned features can be helpful in a classroom setting by providing a more secure environment to store information and work on group projects.

Our goal in this study is to explore whether the use of Sharepoint to increase the availability of procedural data and instructional videos for laboratory experiments will increase comprehension and preparedness for 2000 level biology courses at Worcester Polytechnic Institute. To test our hypothesis, a survey was given to the C Term BB2903 lab students at the end of the term that asked them if the biology wiki site increased their understanding of the material. Students who had taken previous BB290X lab courses were asked if the wiki allowed for greater comprehension of data as well as easier access to the data.

# Methodology

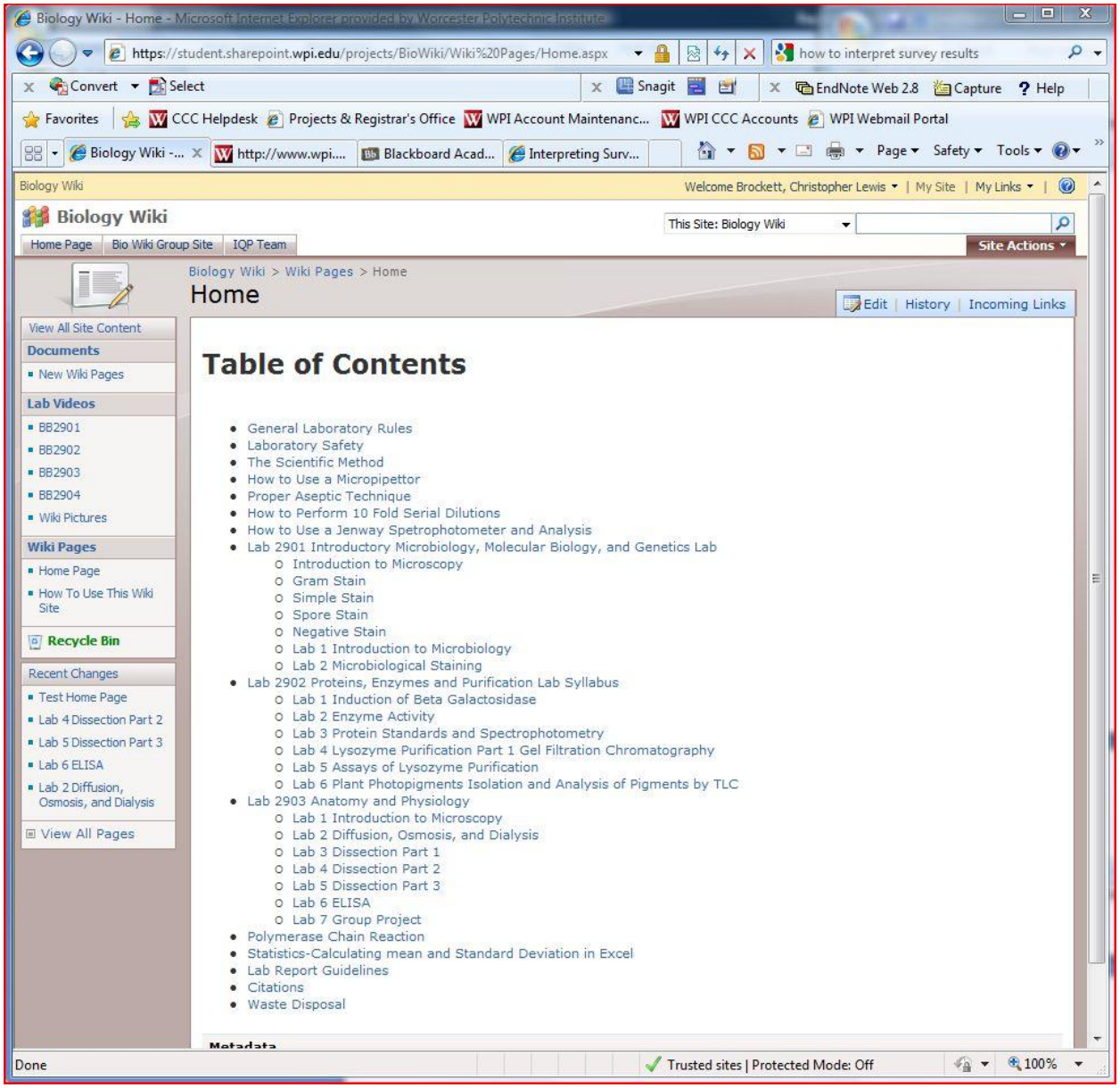
The goal for this project was to create a series of new wiki pages that will include common lab safety practices, lab videos previously created for the WPI Biology labs, procedures for the WPI Biology labs, and descriptions of terms useful for the lab sessions. After studying various methods and receiving feedback from several sources, such as WPI's ATC department and professors from other Worcester colleges, Microsoft Sharepoint was chosen as the most effective hosting tool. Each page for the wiki site was designed with ease of comprehension and navigation in mind. Once these pages were finalized, they were made public for use by the C-Term BB2903 lab students. At the end of the term, the students were surveyed in order to evaluate how effective the students believed the wiki solution was in improving student learning and lab comprehension throughout the course. For a more detailed description of the wiki creation and analysis of results along with visual aids, continue to the Methods section below.

Methods

1. Documents prepared by an earlier IQP (figure 2) were used as references, and relevant keywords were taken for use as titles of the new wiki pages. For example, different types of organisms, lab equipment, or chemicals.
2. Each keyword was sorted into one of five major categories, and then further sorted into subcategories. For example, all statistical analysis methods were placed under the Subcategory Statistics, Main Category Lab Terms. (See figure 3 for more detail)
3. A general format was designed to facilitate easy comprehension of each page using Adobe Dreamweaver. This format was presented to ATC faculty to obtain feedback. (Figure 4)
4. Using the information from the provided lab procedures as well as knowledge gained from online resources and previous personal lab experience, a concise wiki page was written for each of the keywords.
5. The text for each wiki page was written using Microsoft Word because there are no formatting issues when transferring text from Word to a Sharepoint wiki page. It was not written directly on Sharepoint because of the relatively limited options for word processing available when editing a page.
6. The format was designed to have a graphic element for each page of the wiki, some of these were images that were obtained from the Wiki Pictures folder on the Sharepoint Biology Site. For the pages that were found to not have an image available for use from the previously mentioned library, different free media websites, for example Wikimedia Commons, were searched for some options. Also, some photographs were taken of various pieces of lab equipment and chemicals using the digital cameras that are provided during lab periods.

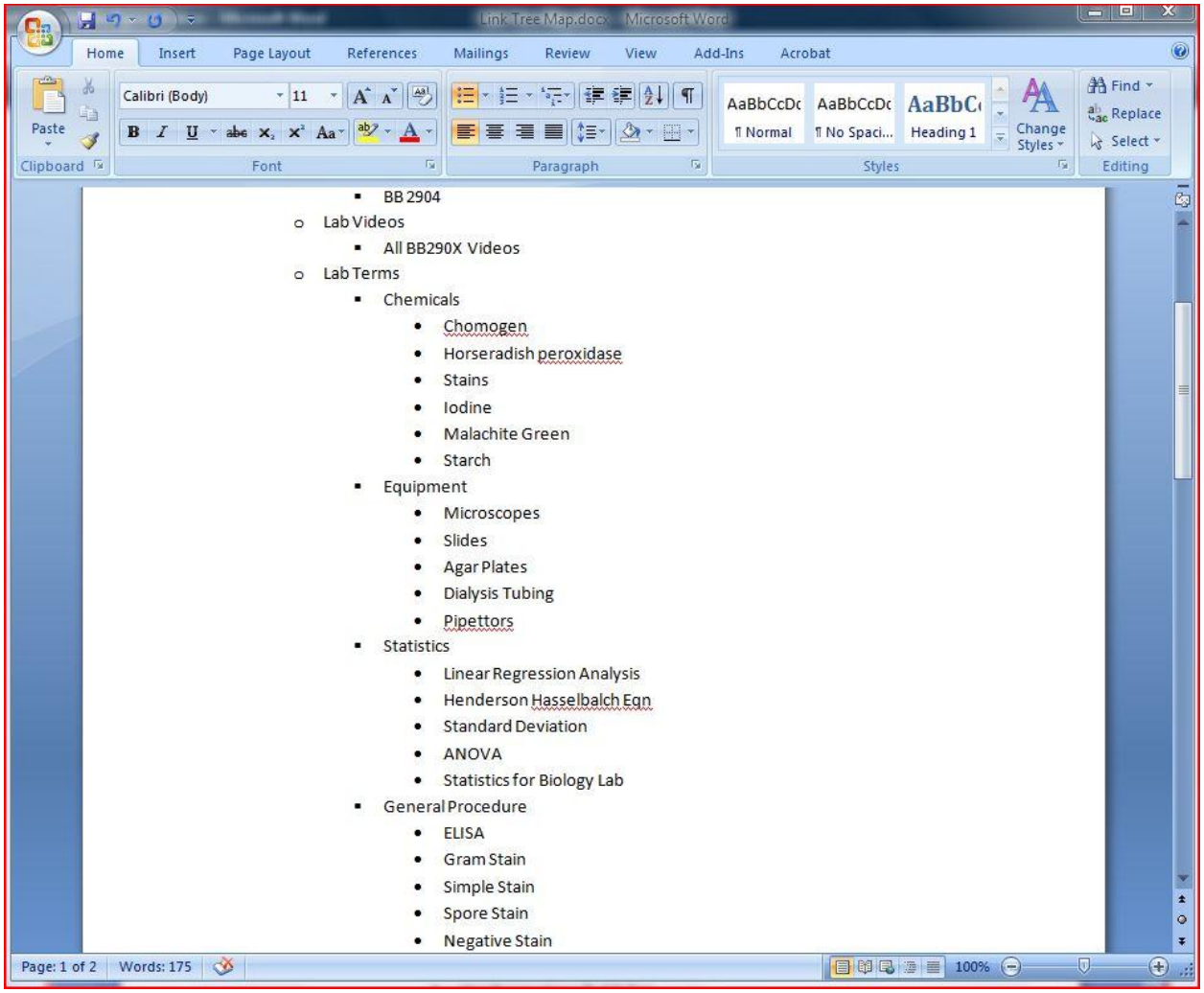
7. Using the document that contained all the links to each of the lab videos made in the previous years (Figure 5) the links were copied and pasted into the appropriate categories, based on the video being for general lab use or for a specific course in the BB290X series. These categories (General, BB2901, BB2902, BB2903, and BB2904) were placed together on the page labeled "Lab Videos" as well as individual pages that are located on the sidebar as quick links for each of the Lab courses.
8. In order to hyperlink all of the pages in the correct order, the same categorized list from step 2 was used to correctly order all of the pages. See Figure 6 for a brief example. By following this list, each page was modified to contain all the links in the subcategory immediately below it. Once all links were created, the wiki site was complete.
9. A short 3 question survey was designed and sent out to biology professors and biology lab assistant professors of 6 local colleges. The survey was aimed at gathering data on what type of technology was used in their laboratories for gathering and sharing student results. The survey can be seen in Figure 7.
10. The wiki was first presented to the C Term lab students during the first class lecture, but they did not have the opportunity to see the wiki until they opened and participated in the first prelab available online through MyWPI.
11. The wiki was continually monitored for site usage, as well as the popularity of specific pages and videos week to week. As the site can only monitor over exactly 30 days, data were recorded on February 18$^{th}$, exactly 30 days after the start of the first class (Figure 8).
12. At the end of the class, students were offered bonus points toward their final class grade if they participated in a survey designed to measure their responses and opinions of the biology wiki site. The survey included 10 multiple choice questions and an example can be seen in Figure 9.
13. The group members met with ATC and discussed how to interpret the data collected from WPI's media server and the SharePoint site usage reports. Pivot tables were used to collate and organize the data from the media server.

**Figure 2. Screenshot of old wiki homepage**



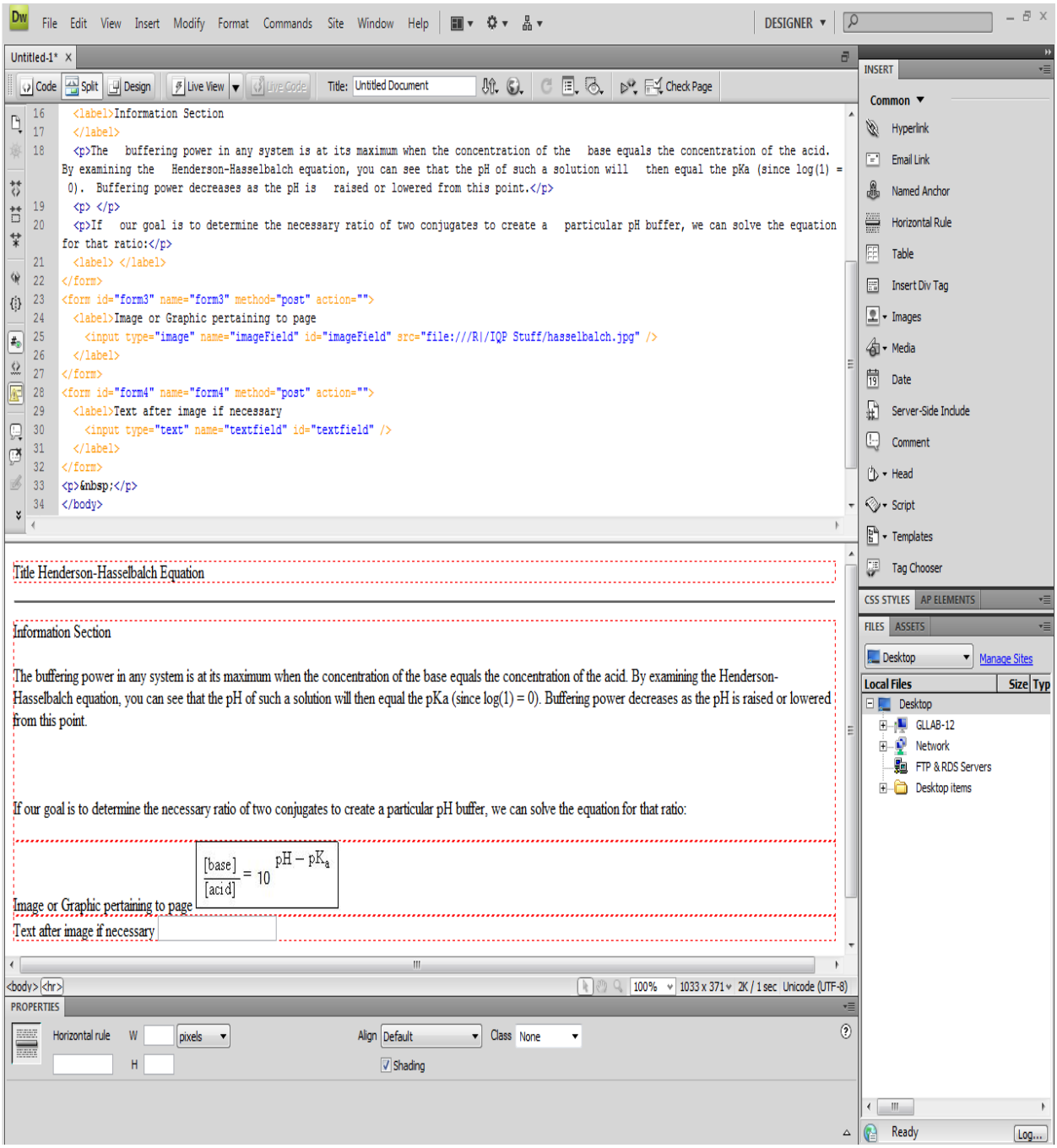

The old biology wiki homepage was very simple. It contained all of the documents on the wiki site in one large list, and did not encompass all of the 290X Biology Lab Procedures. Notice the QuickLink column on the left, which had already been modified from its original settings to include links to the lab videos created during the 2008-2009 Enhanced Lab Learning IQP. To view this older version of the bio wiki, please follow this link.

**Figure 3. List of all Wiki pages**



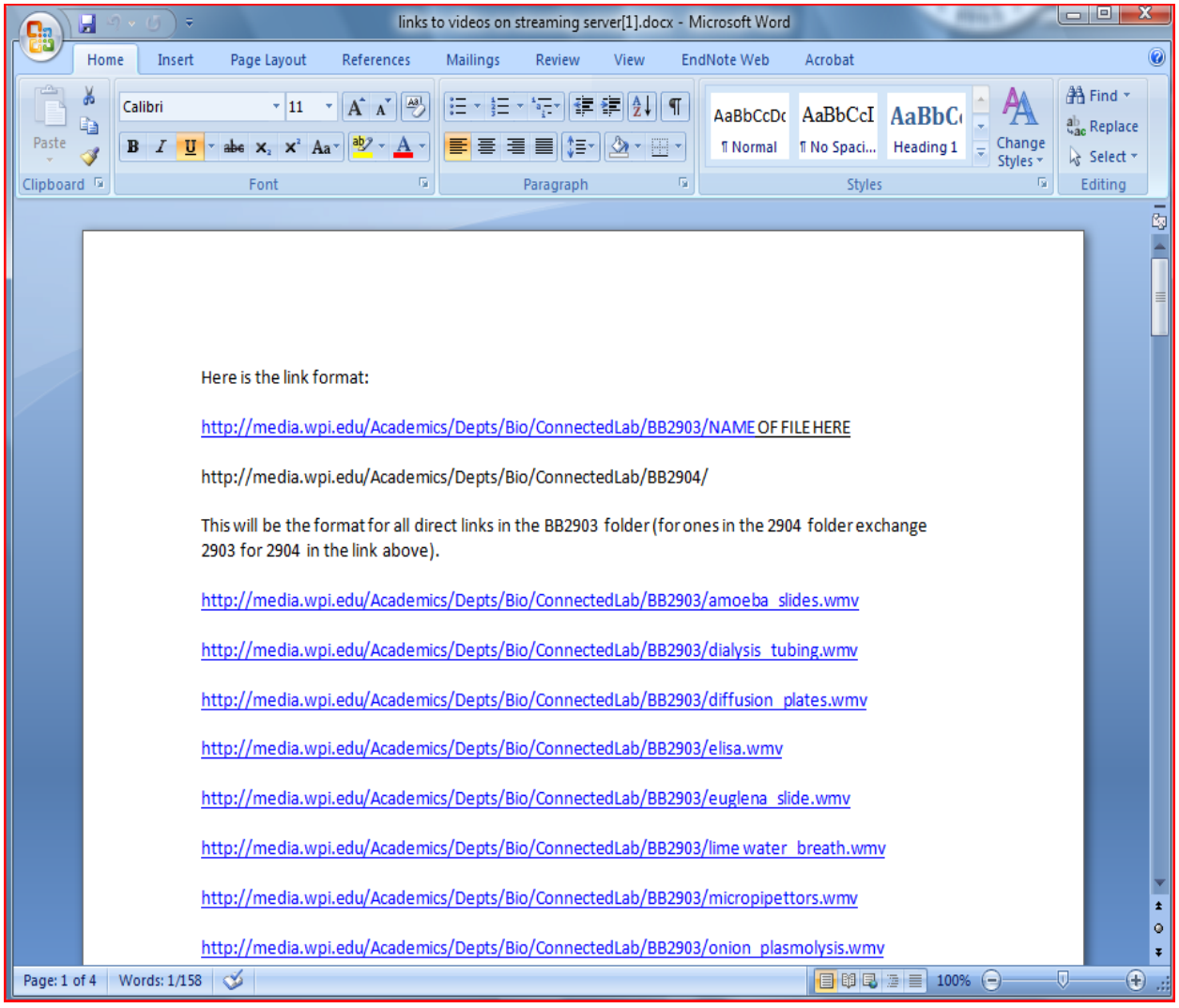

The list partially shown in Figure 2 contains the title of each of the wiki pages created for the new Bio Wiki. The full list can be seen here.

**Figure 4. Construction of General Wiki Page Format**



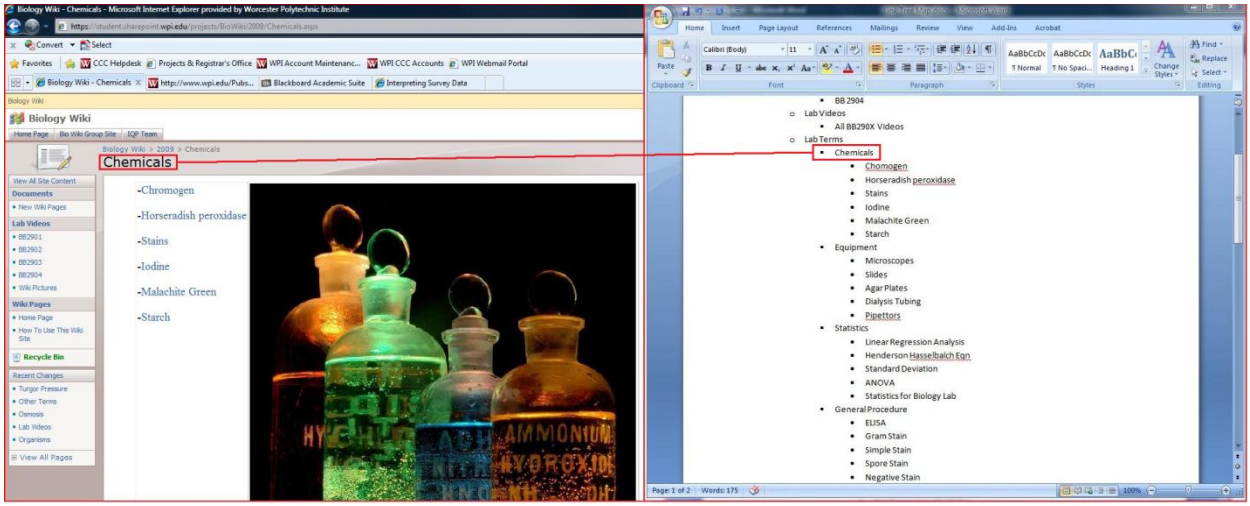

This figure displays the general format of how we created a wiki page with example text and images to give a better feel of how the process went.

**Figure 5. Lab Video Links Document**



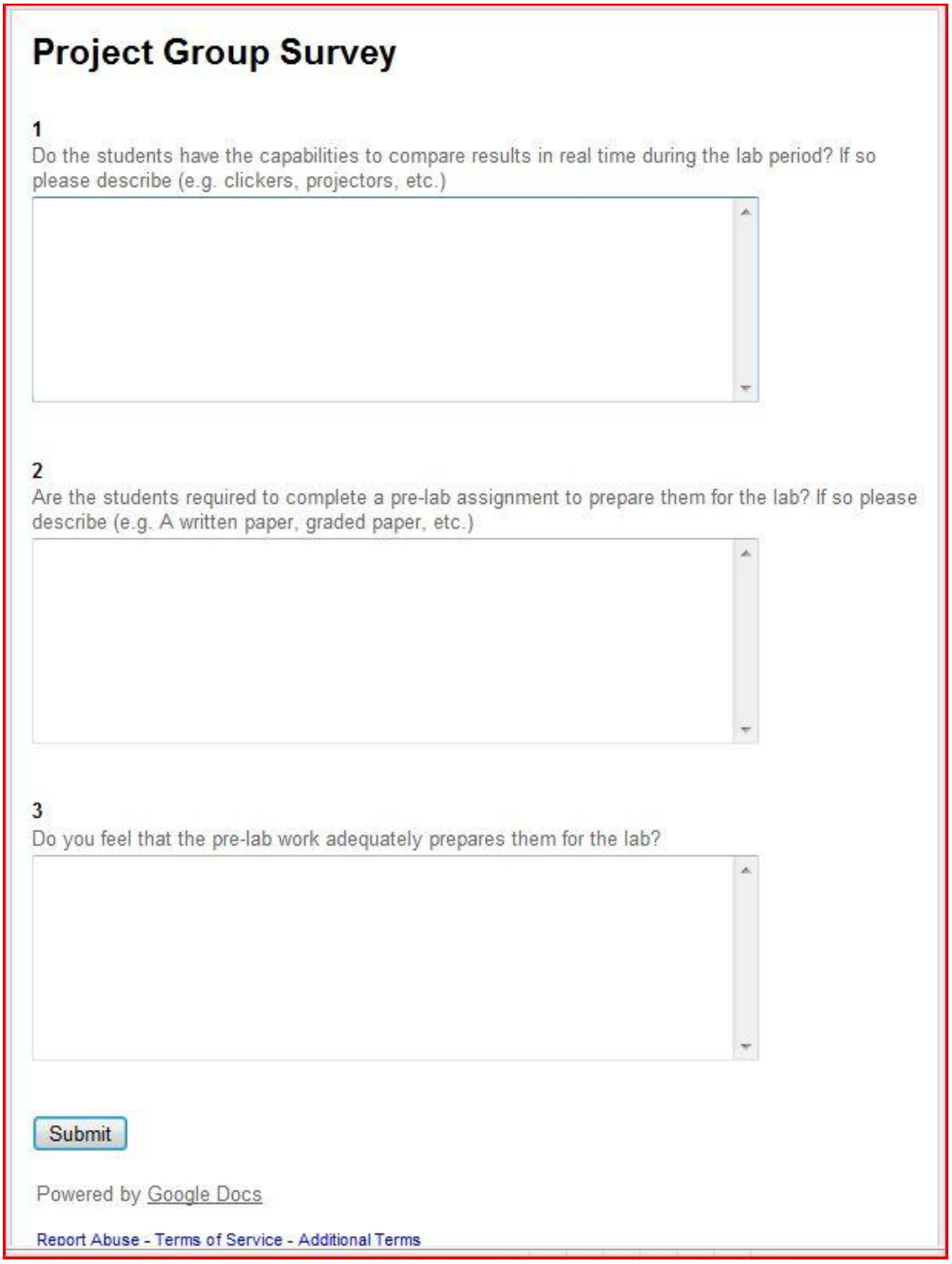

This is a partial list of all of the procedural and instructional videos created for the BB2903 lab class. The full list can be found here.

**Figure 6. Wiki Page – Site Map Correlation**




This figure uses the wiki page titled “Chemicals” as an example to show how the wiki pages were set up using the site map tree.

**Figure 7. Survey Distributed to Local College Professors and Associates**



Project Group Survey

1
Do the students have the capabilities to compare results in real time during the lab period? If so please describe (e.g. clickers, projectors, etc.)

2
Are the students required to complete a pre-lab assignment to prepare them for the lab? If so please describe (e.g. A written paper, graded paper, etc.)

3
Do you feel that the pre-lab work adequately prepares them for the lab?

Submit

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This survey was used to formulate ideas of what other colleges were implementing to help improve their laboratory classes. Results from this survey were inconclusive and are not included in this report.

**Figure 8:** Seen below is the survey given to the students at the end of their experience with our project. Responses will be analyzed and conclusions shall be made which will be discussed in the results section.

# BB2903 Survey for Biology Wiki Site

| | Always | Almost Always | Sometimes | Almost Never | Never |
|---|---|---|---|---|---|
| 1. I visited the wiki site prior to coming to labs… | □ | □ | □ | □ | □ |
| 2. I visited the wiki site during labs… | □ | □ | □ | □ | □ |
| 3. I visited the wiki site while writing lab reports… | □ | □ | □ | □ | □ |
| 4. I attended lectures for labs… | □ | □ | □ | □ | □ |

| | Strongly Agree | Agree | Neither agree nor disagree | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 5. I felt that the wiki site was helpful during labs. | □ | □ | □ | □ | □ |
| 6. I felt that the wiki site was helpful while preparing for quizzes. | □ | □ | □ | □ | □ |
| 7. I felt that the wiki site was helpful in completing my prelabs. | □ | □ | □ | □ | □ |
| 8. I felt that the wiki site was helpful in completing my lab reports. | □ | □ | □ | □ | □ |
| 9. The wiki site reinforced what I learned in lecture. | □ | □ | □ | □ | □ |
| 10. The wiki site was easy to use and navigate. | □ | □ | □ | □ | □ |
| 11. The wiki site content was clearly explained and relevant to the labs. | □ | □ | □ | □ | □ |
| 12. The wiki site was unnecessary - did not aid in learning. | □ | □ | □ | □ | □ |

| | BB2901 | BB2902 | BB2904 | Not Applicable |
|---|---|---|---|---|
| 13. Have you taken any other BB290X courses? (check all that apply) | □ | □ | □ | □ |

14. If you have previously taken any BB290X courses, did the wiki site allow for greater understanding of the material presented?

15. What part of the wiki site did you use most often?

16. Based on your answer to Question 15, in what ways was the part you used most often found to be useful?

17. Which, if any, parts of the wiki were difficult to understand or navigate?

18. Any suggestions for improvements to the site design or content? (please specify)

19. If the option to edit the wiki pages was available, would you have taken the opportunity to improve the wiki? If not what would encourage you to do so?

20. What grade do you expect to receive in BB2903?

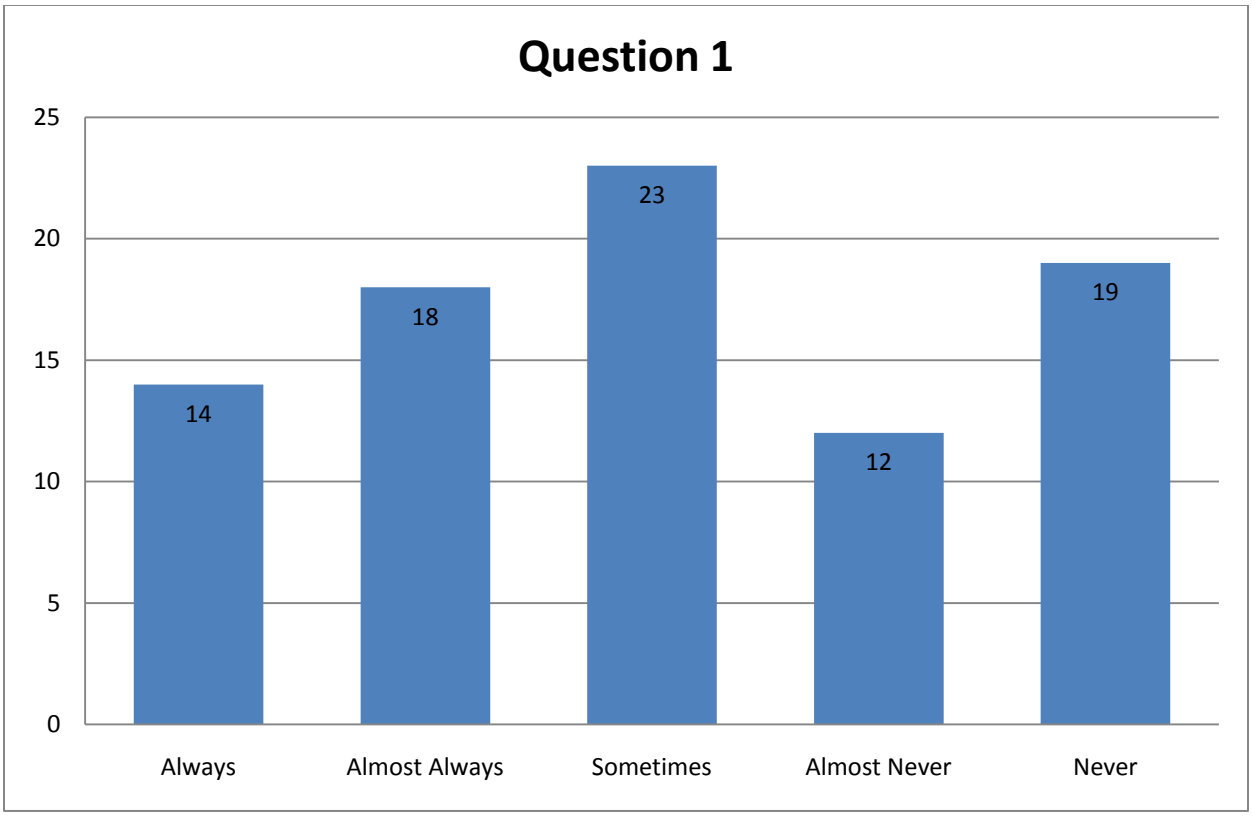
21. Please feel free to leave any other comments or suggestions. (complete with "Not Applicable" if you have nothing to add)

## Results

In the following section the results from the survey (Figure 9) given to the students along with the data received from the media server and wiki site, containing usage statistics, are presented in a visually oriented format. The survey allows us to establish the general feedback from the students who participated in the trial launch of the wiki site. The responses for each of the Likert questions (numbers 1 through 12) and the quantifiable short answer questions (numbers 13 through 15) were documented and placed into a graph for statistical analysis in order to find meaningful results. The rest of the short answer questions (numbers 16 through 21) are more in depth with the goal of retrieving detailed feedback from the students about specific features of the Wiki. The responses of the short answer questions were processed and useful comments were documented to provide ideas for future improvements to the Wiki site.

Question 1: “I visited the wiki site prior to coming to labs…”

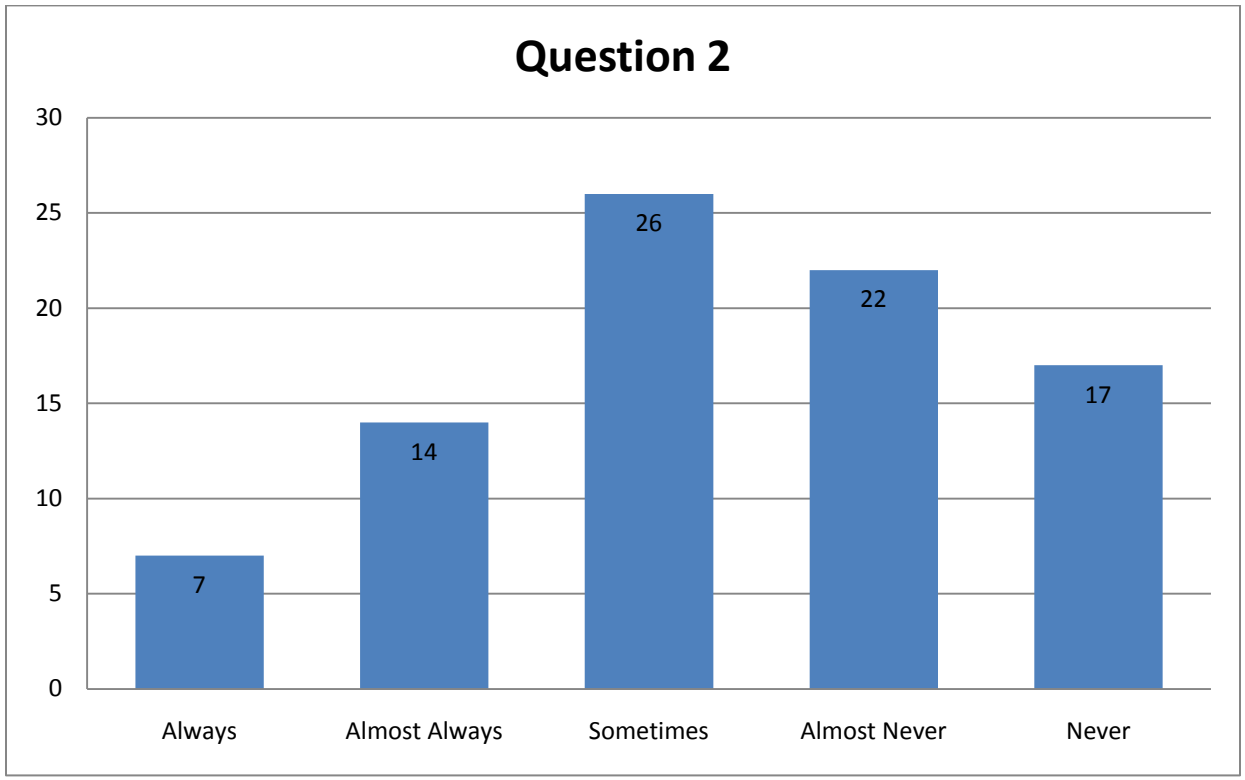
**Figure 9. Results for Question 1**




Pictured above is the graph representing the number of responses given by students for each option for Question 1.

Question 2: “I visited the wiki site during labs…”

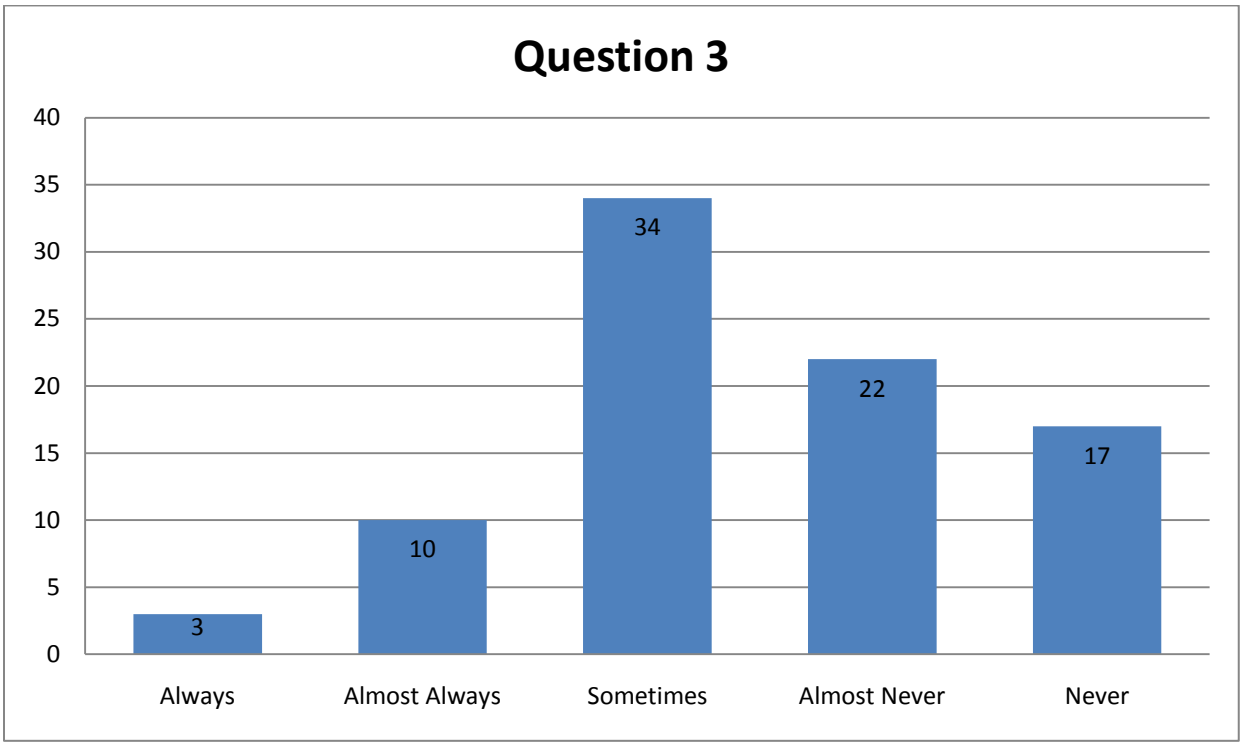
**Figure 10. Results for Question 2**




Pictured above is the graph representing the number of responses given by students for each option for Question 2.

Question 3: “I visited the wiki site while writing lab reports…”

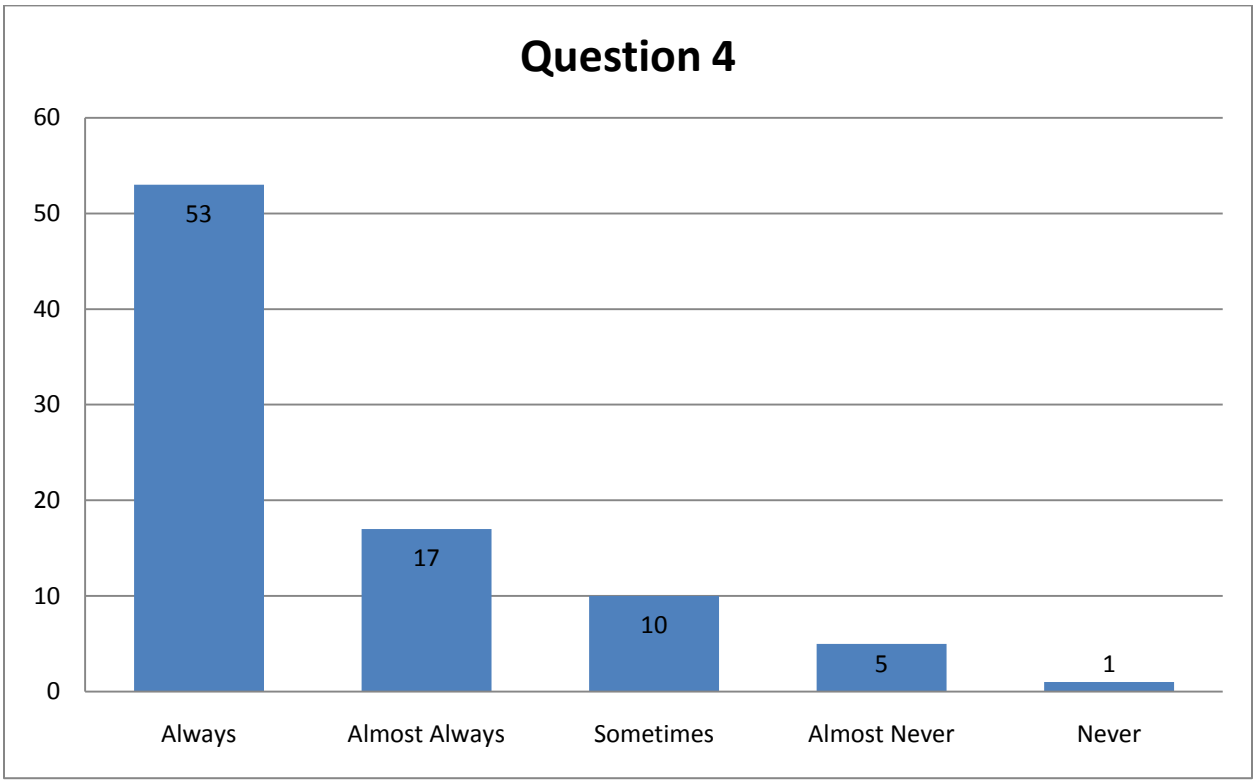
**Figure 11. Results for Question 3**




Pictured above is the graph representing the number of responses given by students for each option for Question 3.

Question 4: “I attended lectures for labs…”

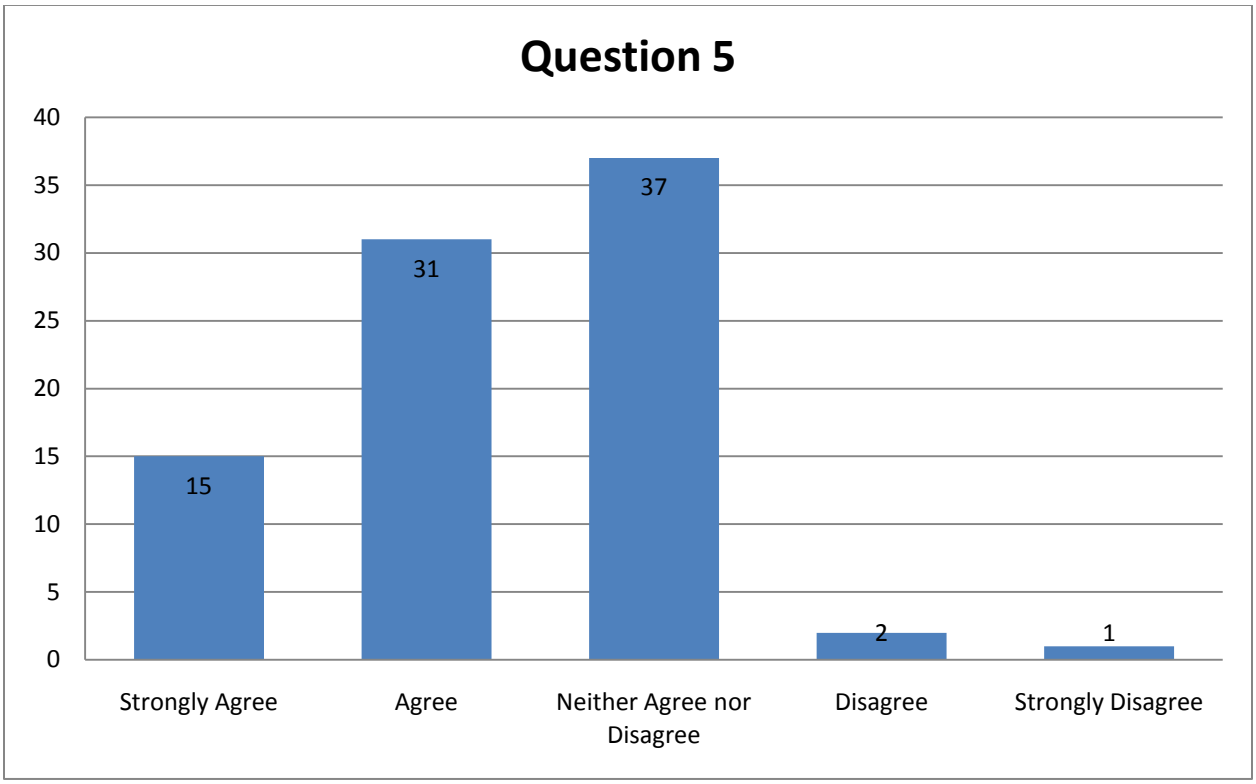
**Figure 12. Results for Question 4**




Pictured above is the graph representing the number of responses given by students for each option for Question 4.

Question 5: “I felt that the wiki site was helpful during labs.”

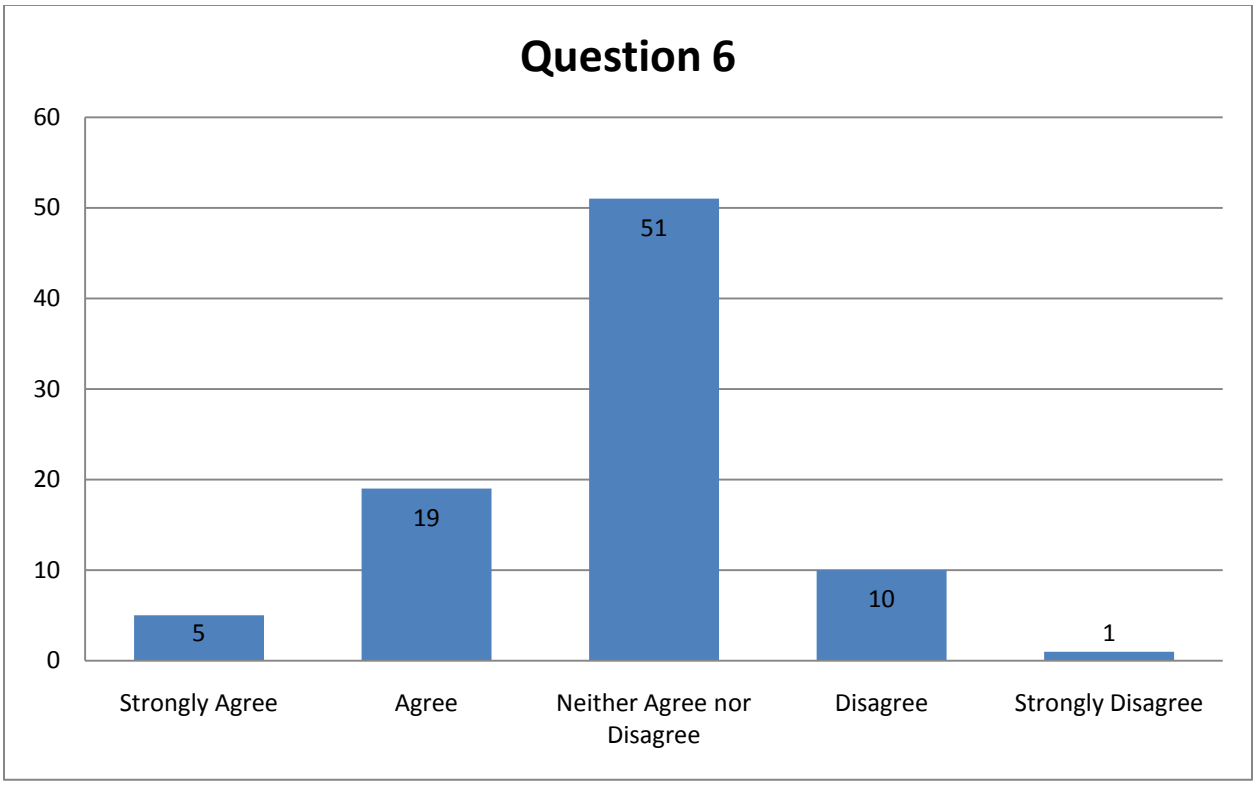
**Figure 13. Results for Question 5**




Pictured above is the graph representing the number of responses given by students for each option for Question 5.

Question 6: “I felt that the wiki site was helpful while preparing for quizzes.”

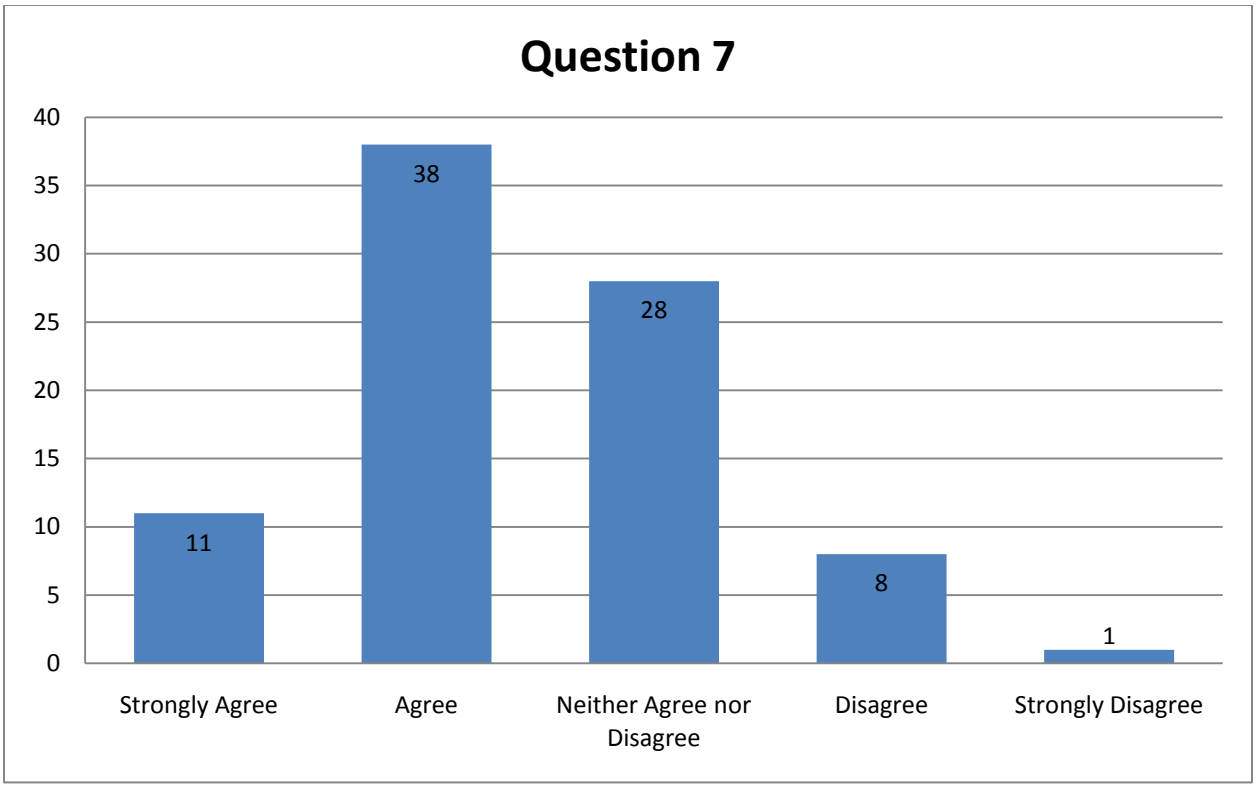
**Figure 14. Results for Question 6**




Pictured above is the graph representing the number of responses given by students for each option for Question 6.

Question 7: “I felt that the wiki site was helpful in completing my prelabs.”

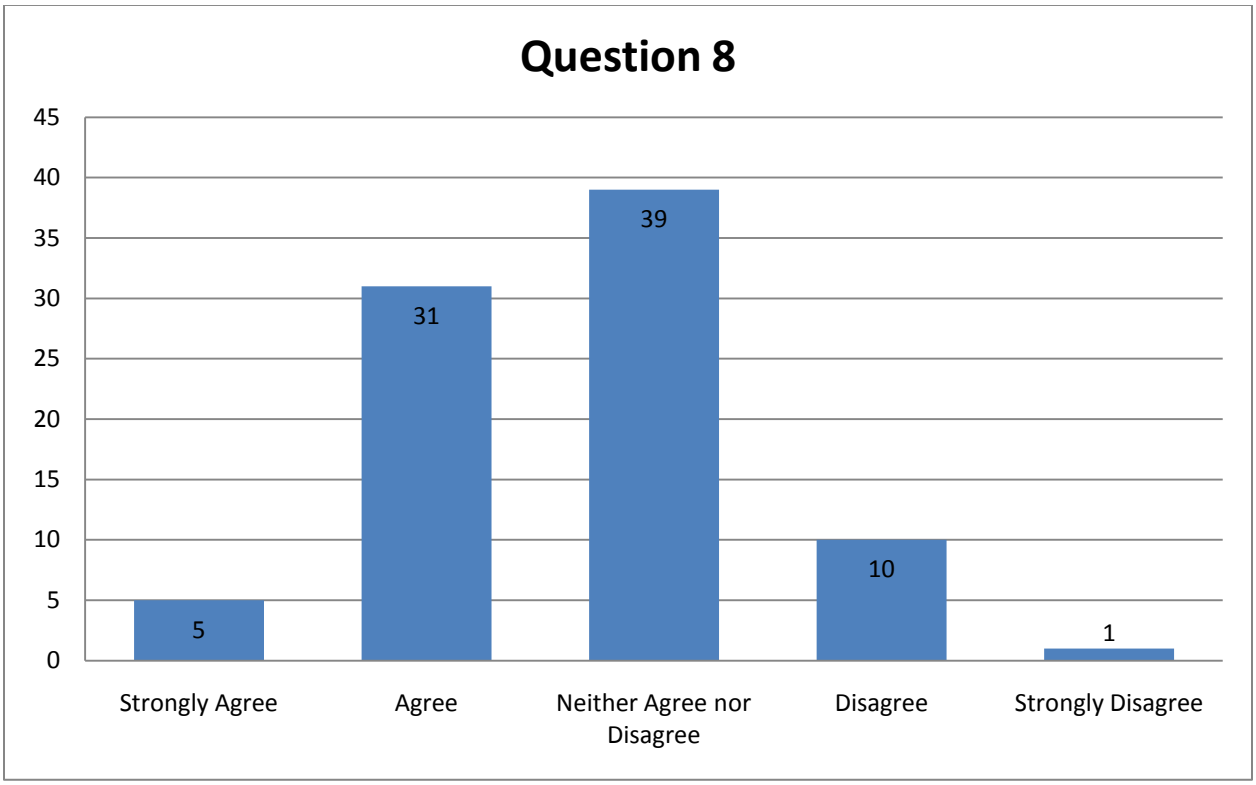
**Figure 15. Results for Question 7**




Pictured above is the graph representing the number of responses given by students for question 7. The data shows that a little more than half the students agreed that the wiki site was helpful for completing pre-labs. Only a small percent felt that the wiki was not helpful with pre-labs.

Question 8: “I felt that the wiki site was helpful in completing my lab reports.”

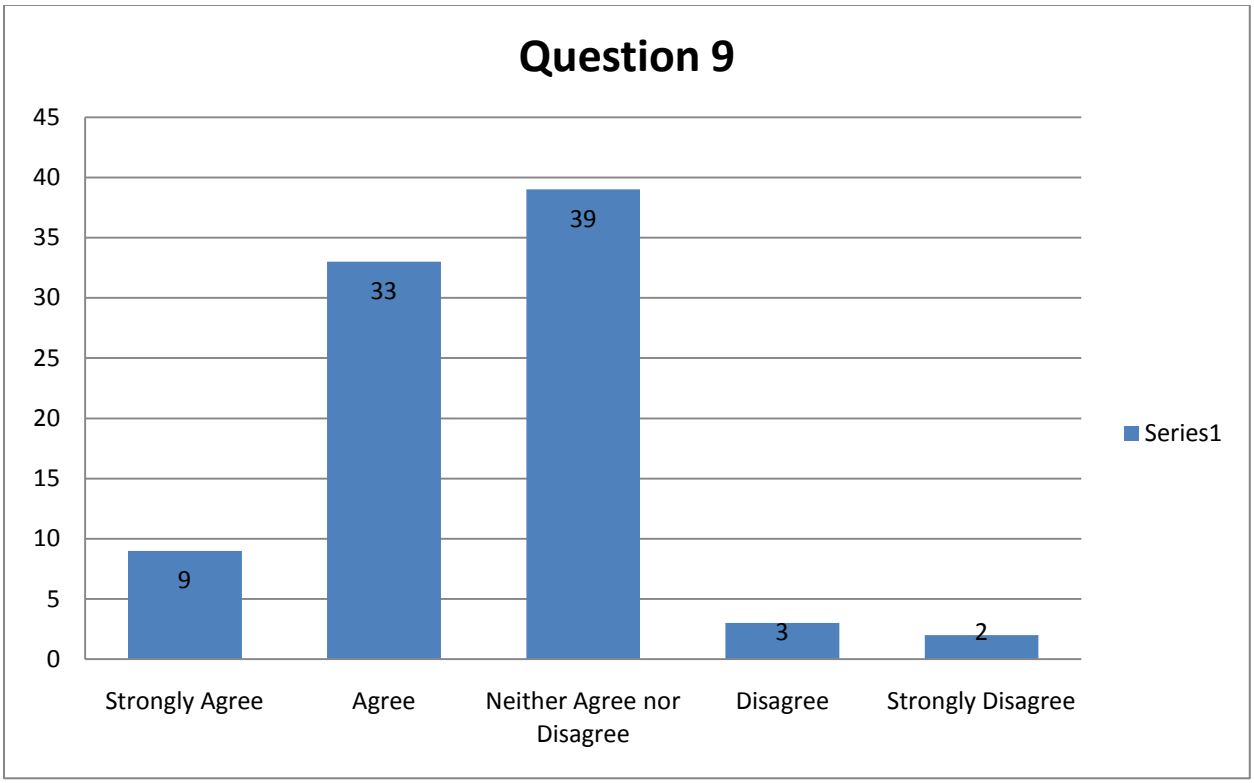
**Figure 16. Results for Question 8**




Pictured above is the graph representing the number of responses given by students for Question 8. The results show that about 40% of students felt the wiki was helpful for lab reports, the majority were indifferent to its effects, and only about 10% felt that it was not helpful.

Question 9: “The wiki site reinforced what I learned in lecture.”

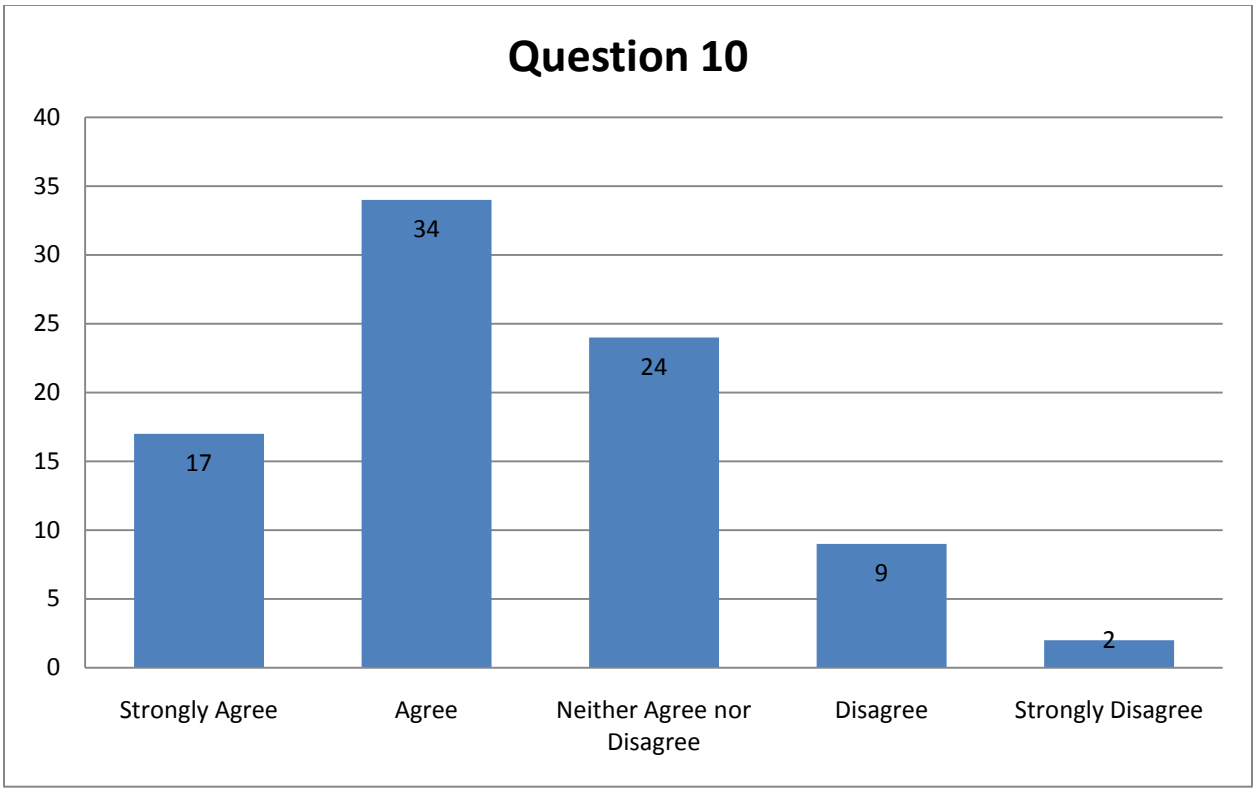
**Figure 17. Results for Question 9**




Pictured above is the graph representing the number of responses given by students for Question 9. This data shows that about half the students agreed that the wiki site did in fact enforce what was learned in lecture, and only about 5% of students disagreed.

Question 10: “The wiki site was easy to use and navigate.”

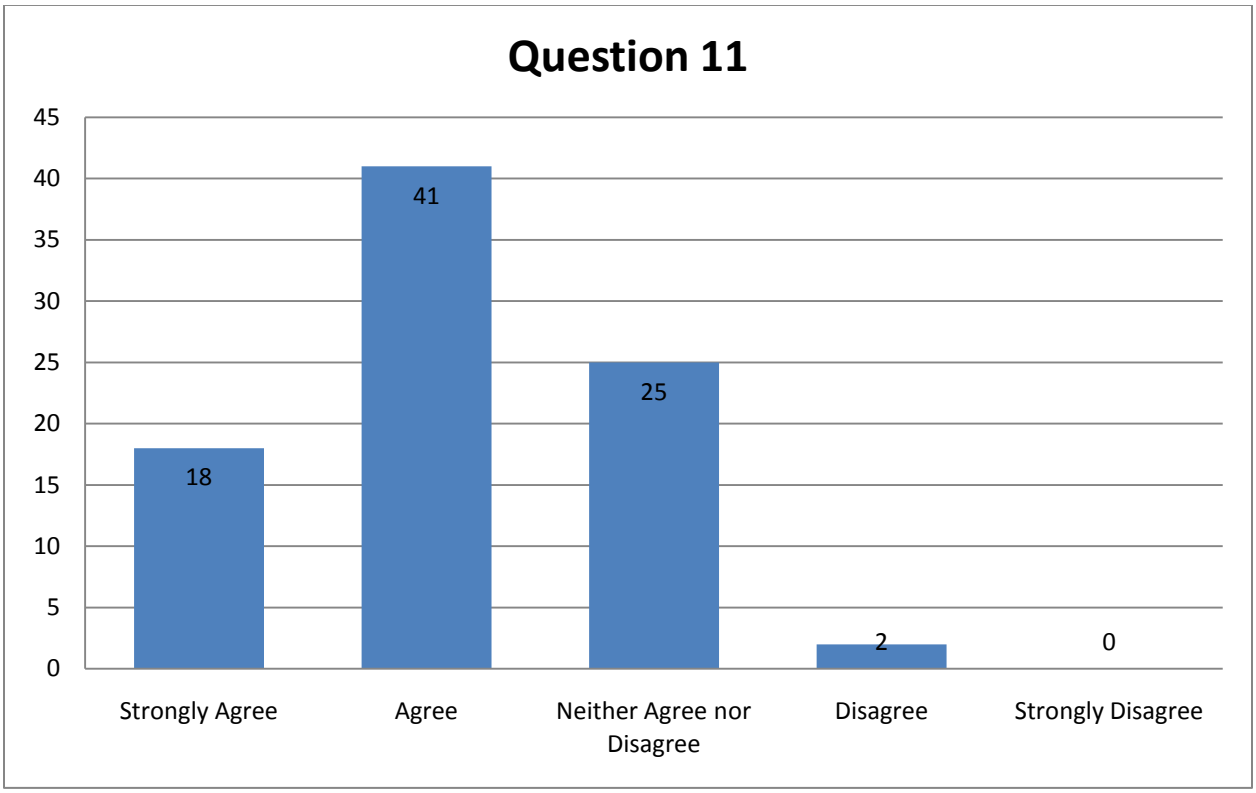
**Figure 18. Results for Question 10**




Pictured above is the graph representing the number of responses given by students for Question 10. This data shows that about 60% of students felt that the wiki site was easy to use and navigate where only about 10% of students disagreed.

Question 11: “The wiki site content was clearly explained and relevant to labs.”

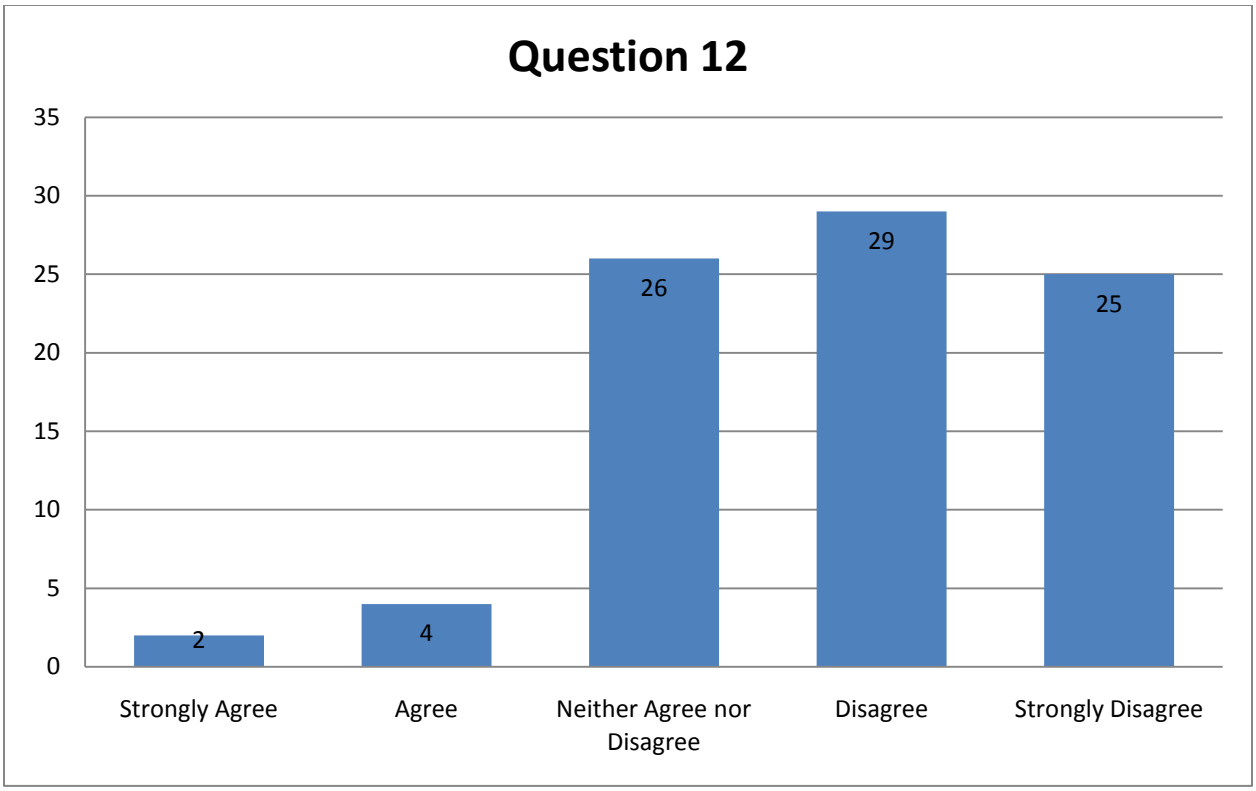
**Figure 19. Results for Question 11**




Pictured above is the graph representing the number of responses given by students for Question 11. This data clearly shows that the majority of students felt that the wiki site was clearly explained where only 2 students felt it wasn’t explained well.

Question 12: “The wiki site was unnecessary – did not aid in learning.”

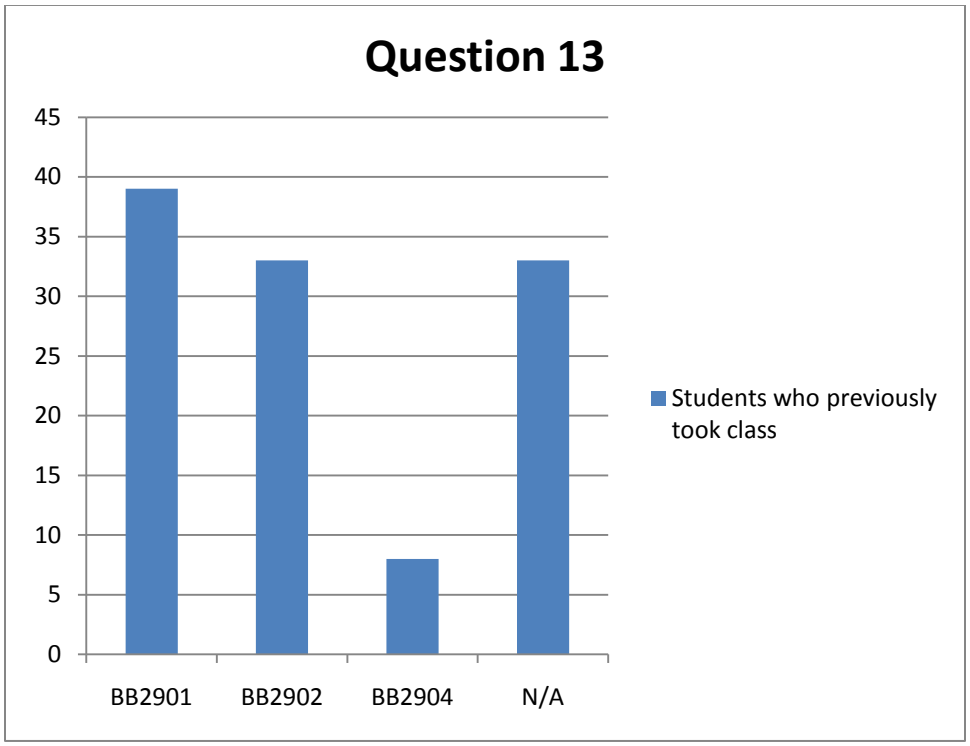
**Figure 20. Results for Question 12**




Pictured above is the graph representing the number of responses given by students for Question 12. The data for this question shows that only a small percentage of students, about 5%, felt the wiki site was unnecessary whereas the vast majority, about 65%, felt that the wiki site was useful.

Question 13: “Have you taken any other BB290X courses? (check all that apply)”

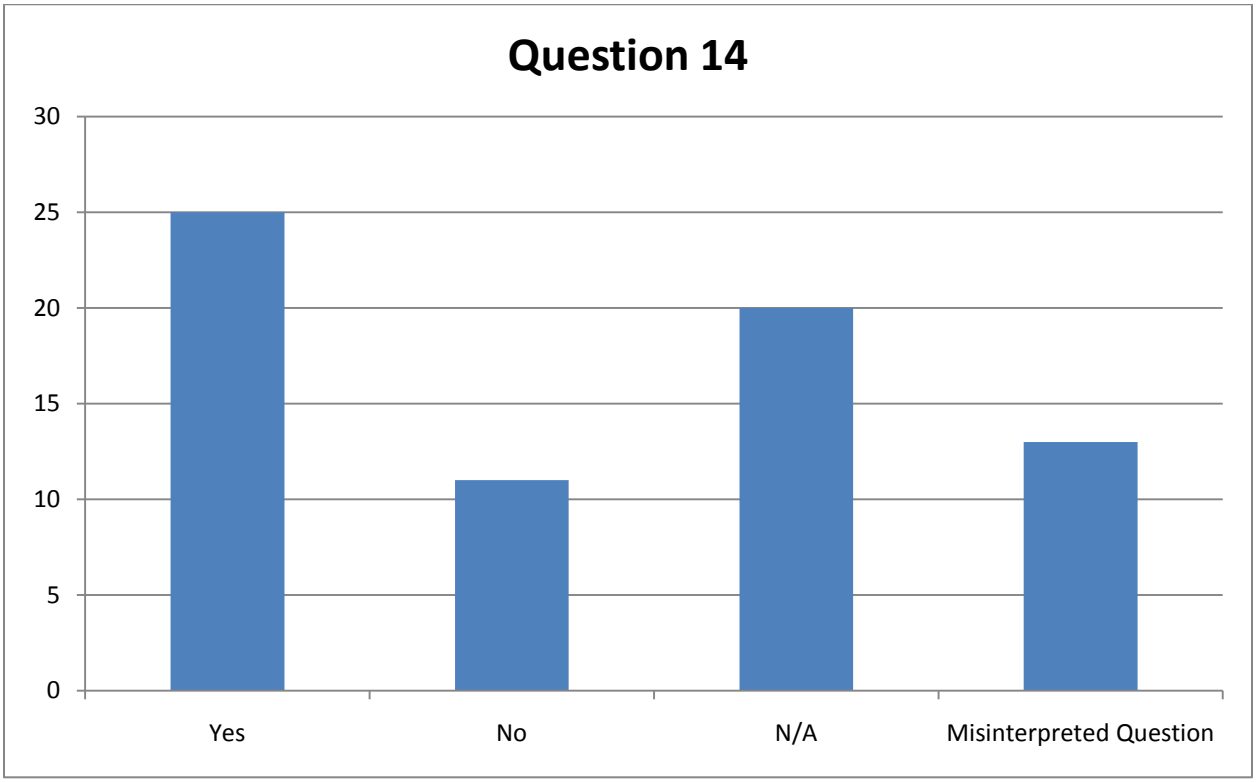
**Figure 21. Results for Question 13**




Pictured above in Figure 21 is the graph representing the number of students who were previously in another BB290X course. Almost 40% of the students had not taken a previous lab course.

Question 14: “If you have previously taken any BB290X courses, did the wiki site allow for greater understanding of the material presented?”

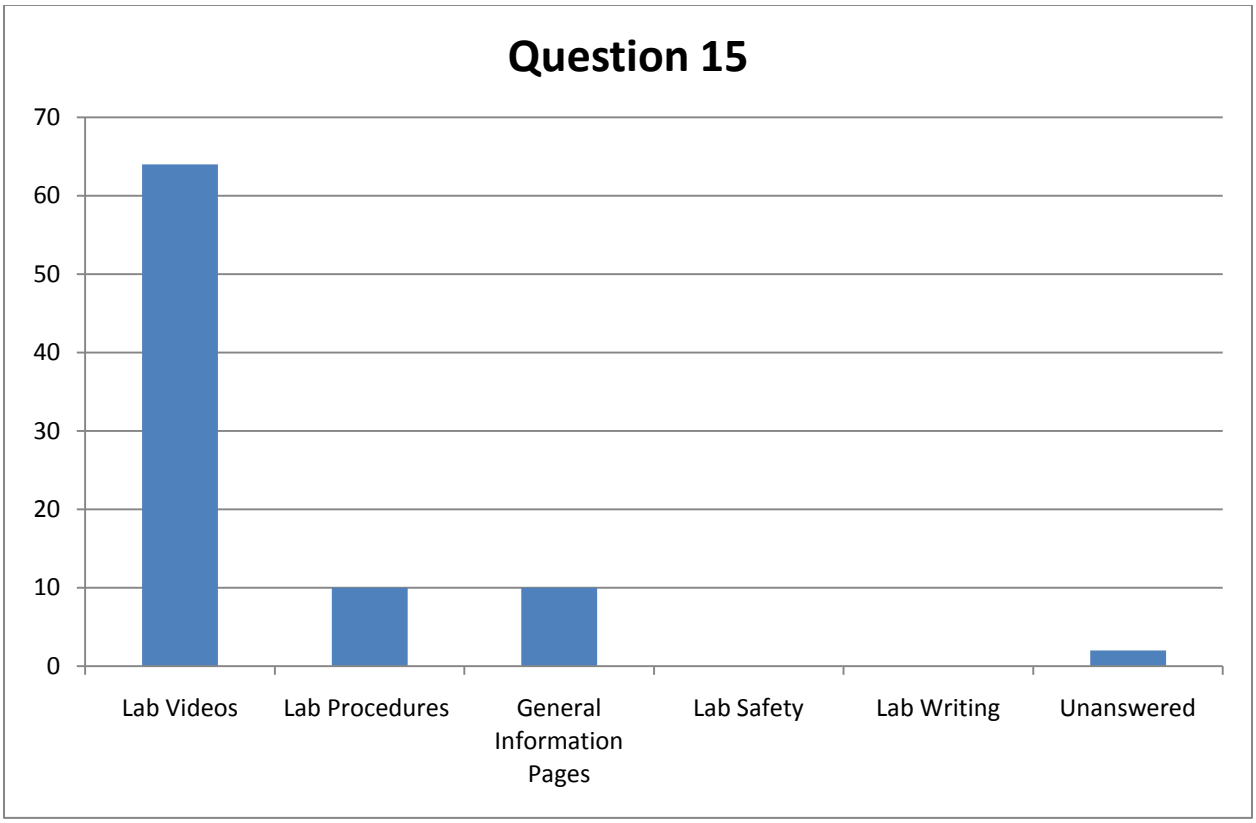
**Figure 22. Results for Question 14**




Pictured above is the graph representing responses given by students for Question 14. Many students misinterpreted the question, believing that the question indicated that the other BB290X courses also had Wiki sites similar to the one created for this project, which was false. 70% of those who answered the question in the spirit it was asked agreed that it provided greater understanding of the material, while the other 30 did not.

Question 15: “What part of the wiki site did you use most often?”

**Figure 23. Results for Question 15**




Pictured above in Figure 23 is a tally of the responses to Question 15 of the student survey. Almost all of the students utilized the Lab Videos section the most, with Lab Procedures and General Information Pages tied for second.

**Figure 24.**

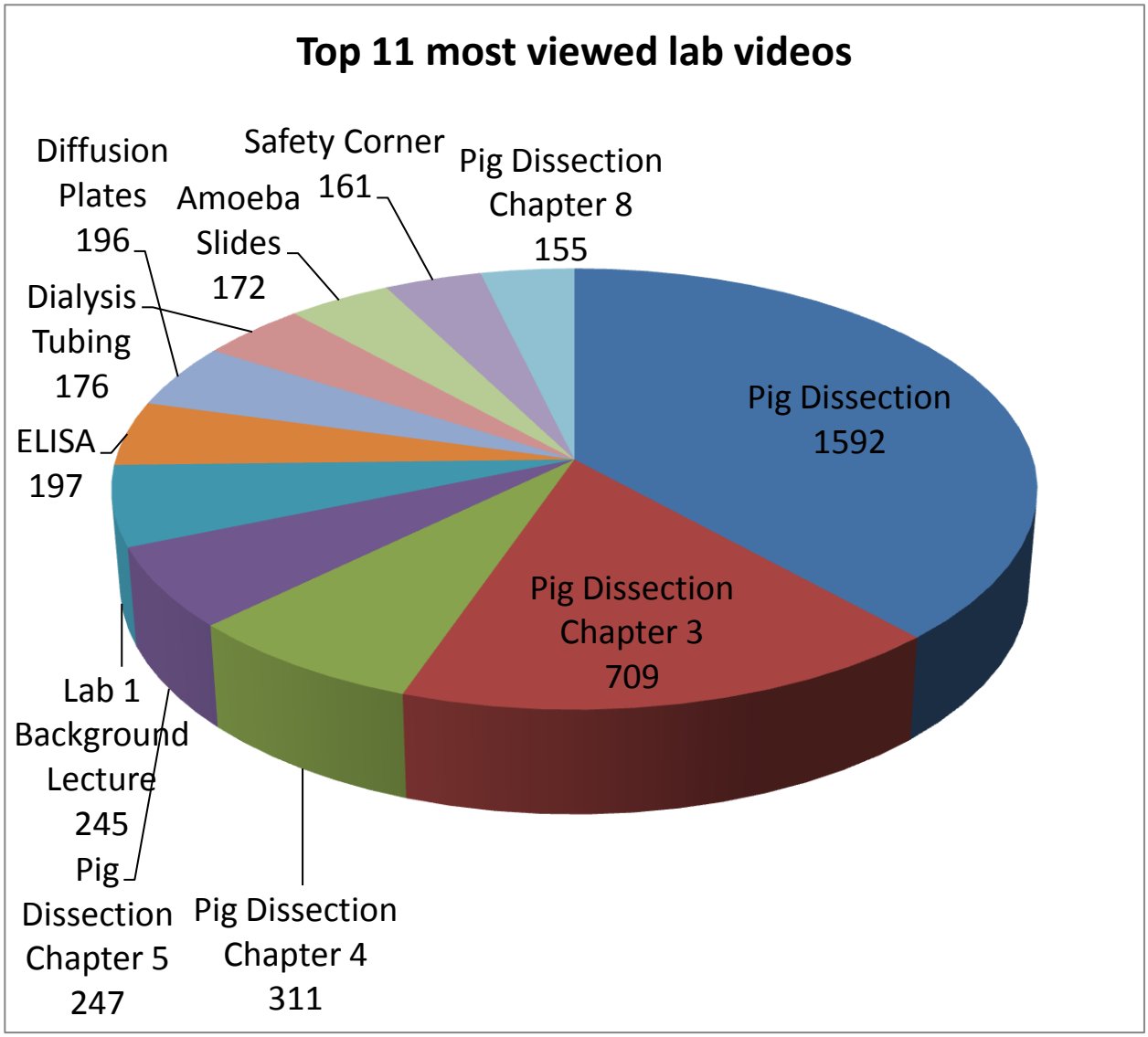



Figure 24 shows which videos were watched the most. The pig dissections were clearly utilized the most, taking up over half of all the views.

**Figure 25.**

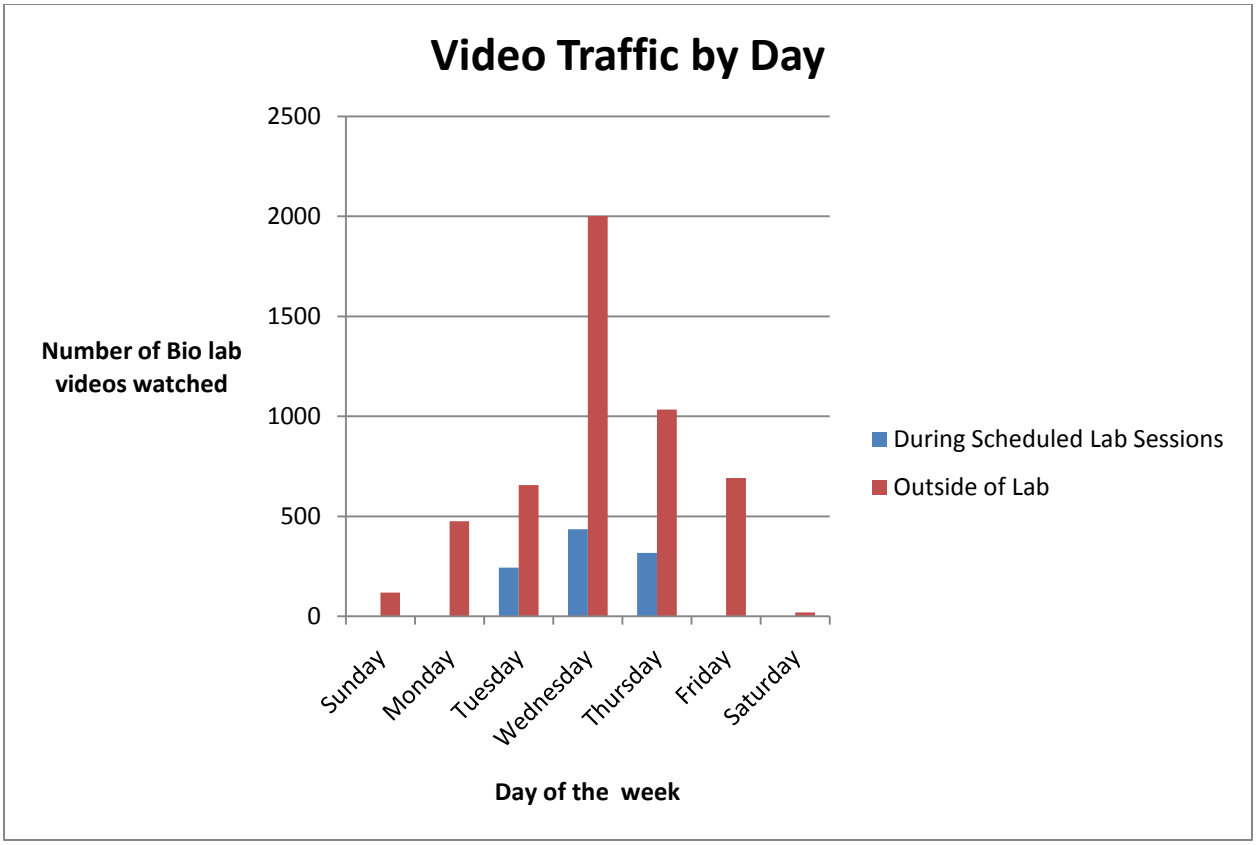



Figure 25 above shows the number of videos watched by the BB2903 lab students by day. Wednesday was the most popular day, both for during lab and out of lab, with over 30% of all views during the term.

**Figure 26.**

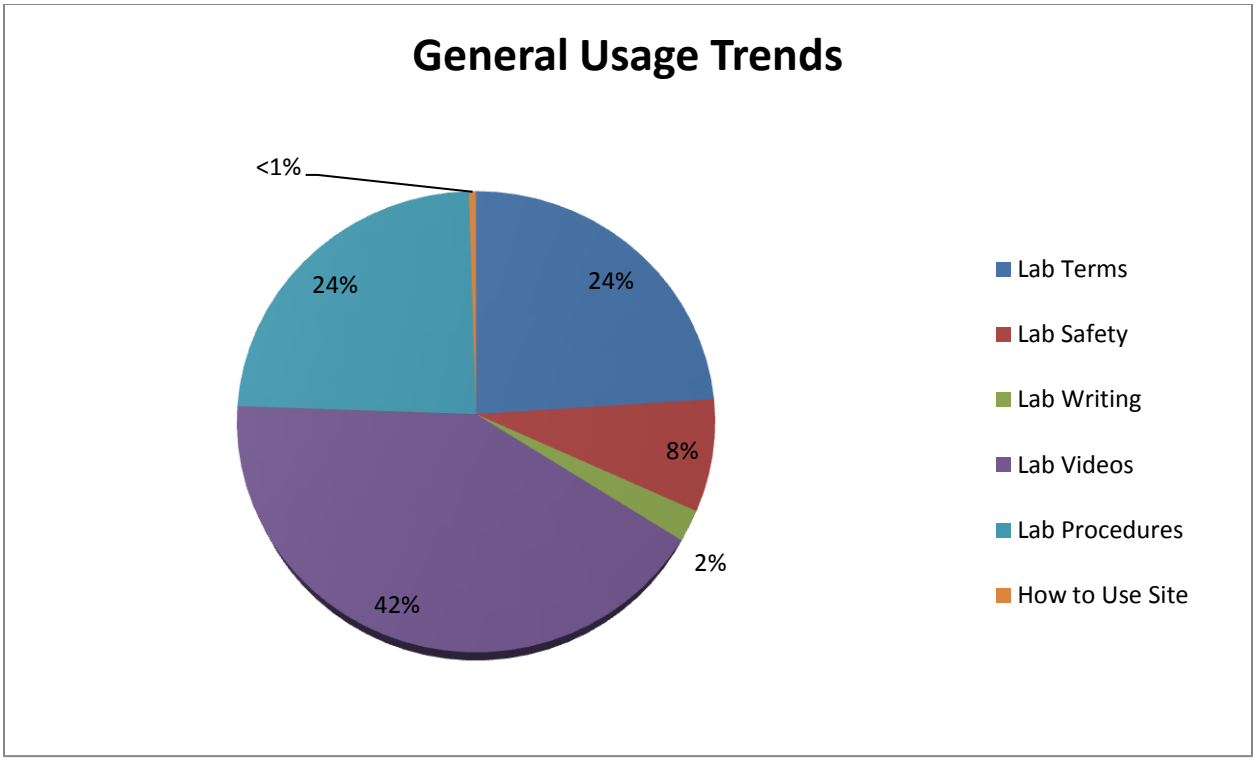



Figure 26 represents how often the different sections of the Wiki site were visited by the lab students. The Lab Videos section was the most popular, with the terms and procedures equal at second most popular.

## Discussion

The purpose of this project was to create a wiki site that would increase the availability of information and materials related to the BB2903 laboratory class, in an effort to aid in student learning. The results in the previous section will be analyzed and conclusion will be drawn as to the success of the project as represented by the data. Any possible future improvements or suggestions for additional research will be presented along with the relevant data and discussion.

The wiki site was visited most often when the students were working on their prelabs. Questions 1-3 on the student survey gathered data on when the students visited the wiki site for information, procedures, and to watch videos. It was observed in Figure 9 that only 19 students never visited the site, and 14 always used the site for their prelabs. For a more accurate picture, the assumption was made that students who 'Always' used the site visited 7 times, one for each lab. Students who "Almost Always' visited were assumed to use the site 5-6 times, those who 'Sometimes' visited 3-4 times, and those who 'Almost Never' visited 1-2 times. For prelabs, the students visited the wiki site almost 300 times over the course of the term, and 78% of the class visited at least once.

Figure 10 shows how often students used the wiki site during laboratory experiments. The results show that fewer students used the wiki site during labs overall, with only about 250 unique visits during the term, but there were also fewer students who 'Never' visited the site during lab compared to prelab use. Figure 11 contains data representing how often students visited the wiki site during the writing of the lab report. Over 80% of the class visited the site at least once, but there were only 230 unique visits. It can be inferred that the wiki was useful throughout each part of a lab but after finding the information on the site for the prelab, fewer students needed to visit a second or third time during the experiment or the report writing.

The fourth question "I attended the lectures for the labs…" accompanied by a Likert scale, with the extremes being always and never, was designed to provide us with an idea of how many of the students regularly attended lectures for class. With this information it becomes possible to confirm or deny trends that may arise from questions later on in the survey such as question nine where it is asked if the wiki reinforces material presented in lecture. Also, although attendance does not always reflect performance, it provides a general sense of the students overall initiative at achieving success in this course. The data from question four shows that a vast majority of students attend the lectures for labs from which it can be interpolated that a large portion of students will take advantage of all available resources, such as the wiki. This trend makes it possible to assume that the majority of students will be responding to our survey in an honest fashion making the results relevant and able to be analyzed.

The fifth question "I felt that the wiki site was useful during labs." accompanied by a Likert scale, with the extremes being strongly agree and strongly disagree, was designed to provide us feedback on how viable if would be to pursue avenues of a more in class based experience with the wiki for the future. The data appears to be inconclusive showing about a 50/50 split between agreeing that it was useful in class and not having an opinion either way. This data can be taken in two ways, first that it is not a useful strategy to employ the wiki site during lab times, or second that more research needs to be completed on wiki capabilities to find new functions or find new ways for functions to be employed effectively during lab times.

The sixth question "I felt that the wiki was helpful while preparing for quizzes." accompanied by a Likert scale, with the extremes being strongly agree and strongly disagree, was the first of the three questions designed to see what other uses the wiki has promise for excelling in. The results of the question show that the majority of students were unresponsive to this question answering "neither agree nor disagree". It can be inferred that these answers mean that the wiki site was not used for studying for quizzes as a primary function. This result leads to the conclusions that either not enough relevant course information was available or the wiki was not as convenient as studying with the help of other means.

The Seventh question, "I felt that the wiki site was helpful in completing my prelabs." accompanied by a Likert scale with the extremes being strongly agree and strongly disagree, provides feedback on how useful the wiki site was for students use while completing the preliminary laboratory assignments. The vast majority of students replied with positive feedback entailing that the wiki site was quite useful for this purpose. Judging by responses from alternate questions there are several students that have little opportunity to use the wiki because of the limitations of using Sharepoint on a Mac with Firefox. These technical problems could account for the negative responses of the question. The only suggestion to be made for future groups would be to update the wiki to make sure that it encompasses necessary information to complete the pre-labs for the other BB290X series courses.

The Eighth question, "I felt that the wiki site was helpful in completing my lab reports." accompanied by a Likert scale with extremes being strongly agree and strongly disagree, is intended to express how well the students were able to use the wiki while working on completing lab reports. The results of this question suggest that the class seemed to be ambivalent about the helpfulness of the wiki site for lab reports but leaning towards the positive side. With half the class answering 'neither agree nor disagree' and the other half agreeing with the statement more work could be done to accomplish this aspect. One idea that could be explored to determine the feasibility would be similar to what was done with the Google Docs live data entry during the labs. It may be possible, if students are allowed to edit site content, to create a page on which each separate lab group is responsible for updating their results and data providing a comparison to make sure everyone is following the same trend assuring that no one uses data that is skewed in a report.

It was important for the wiki to be easy to use and have clear, relevant content so that it could aid in learning. As figure 18 shows, most students, 51.3%, agreed that the wiki site was easy to use and navigate. Only 12.8% of users disagreed with the majority of students. These results could be affected by many variables. One of which could be the browser used to access the site. If a student had trouble accessing the site, then they would say that the wiki was not easy to use. It can be assumed that students that thought the wiki was easy to use and navigate could easily access the site and any information from the site that they would need. Figure 18 shows the results for how clear and relevant the students thought the wiki information was for the labs. Only 2.3% of students disagreed that the wiki site content was clearly explained and relevant to the labs, all other students surveyed thought that the wiki site was clearly explained and was relevant to the labs. These results strongly support the claim that the wiki site was clearly explained and relevant to the BB2903 labs. The findings from questions 10 and 11 on the survey are factors to consider for the responses for question 12. Figure 19 shows the responses for how many people thought that the wiki site was unnecessary and did not aid on learning. About 30% of people "neither agreed not disagreed", which could be interpreted as not hurting or helping with comprehension of the lab material. About 63% of users disagreed with the statement "the wiki site was unnecessary and did not aid in learning". Most people agreed that the wiki site was helpful with learning the material relevant to the lab. These results should be considered when looking at the overall effectiveness of the wiki.

Question 13 from the survey gathered data on what other similar lab courses student had taken prior to the 2010 BB2903 course. Thirty-three students had never taken a previous lab course, while the other 53 had taken at least one. Seventy-three percent of those students took BB2901, sixty-two percent took BB2902, and fifteen percent took BB2904. Question 14 of the survey focused only on the 53 students who had taken a previous biology lab course. They were asked "If you have previously taken any BB290X courses, did the wiki site allow for greater understanding of the material presented?". This question was ambiguous and misleading. The true intent behind the question was to discover if the wiki site allowed for greater understanding as compared to a lab class with no wiki available. Some of the students were confused by the question and believed it was asking to compare the C-Term wiki site with nonexistent wiki sites for the other lab courses (BB2901,BB2902, and BB2904). Analysis of the answers allowed for separation of those who answered while understanding the question from those who answered with an incorrect view of the question. Figure 21 shows that 17 students answered the misinterpreted question, while the 33 students who did not take a previous lab class chose N/A. Of those who did answer correctly, seventy percent found that the wiki site allowed for greater understanding of the material, while the other 30 percent did not. Student comments in favor of the site noted that the videos were easy to find and navigate, and that the site "was useful for clarification when the procedure or pre-lab was unclear." Several students who did not believe that the site helped often commented that they could not access the site due to technical difficulties that should be fixed for future classes. These technical difficulties most likely arose due to the student using a Mac computer from off campus, or using a browser other than Internet Explorer. Both of these can cause problems when accessing the WPI Sharepoint site.

Question 15 of the survey asked the students which area of the site they used the most. 75% of the students believed that the Lab Videos section, where all of the procedure and safety videos were organized, was the most useful. The rest of the students were split evenly between the Lab Procedures section and the General Information pages with 11% each. Two students responded with an N/A, indicating that they did not use the Wiki Site. Question 16 of the survey asked the students to provide a reason for their answer in Question 15. The students who visited the lab videos section most often were almost unanimous in their opinion that being able to visually experience the proper procedure greatly increased their understanding of the proper actions and methods for completing the labs. Another common reason was that instruments and tools that the students may have never used before were identified in the videos, offering a clear demonstration of correct use. The students who visited the general information pages the most largely commented on their usefulness while completing the prelabs. The terms and concepts used in the lab procedures were present in the general information pages, allowing the students to easily search for any unknown or forgotten piece of information. The students who used the lab procedure section the most found it very helpful to have an electronic copy of their labs with them, and in some cases used just the electronic version found in the procedures section of the project Wiki site.

Much of the survey is based on receiving feedback from the students about the information or content available on the wiki site, Question 17 and 18 deviate from this and ask for feedback regarding the wiki site design and ease of use. In question 17 the students are asked if any particular parts of the wiki that stood out as being difficult to navigate or understand. Although the majority of the responses given showed that students felt there were no problems with the wiki, this question was intended to uncover any details that may have been overlooked. The main problem that seemed to have been pointed out was the organization of the general information; the videos were easy to find and access. An approach to solving this issue could be to include a general site map, using the concept of Figure 3 but with a more interesting design, on the quick link sidebar to give students an idea of the layout of the site. This would introduce students to the layout of the site, reducing the problems of navigation, as well as provide a template for adding new content and making users aware that new content was available with proper labeling (i.e. “New Content Name” *NEW!*).

In question 18 students are asked to provide any suggestions or ideas that could improve the current wiki site. Most of the responses were not applicable, and a few were centered about problems that Apple/Mac computers had with Microsoft Sharepoint compatibility, something that is beyond the scope of this project. Some of the answers provided what could potentially be a great initiation point for students looking to continue to improve this project in the future. Beginning with the issues that focused on the structure and design of the wiki, it was suggested that the wiki could have more sidebar quick links to important relevant material which could improve site navigation which has been brought up already. One response mentioned a solution to the hassle of accessing the wiki, which entails posting a link of the wiki site directly on the

MyWPI page that students have access to for the labs. Some students also asked to see some sort of discussion board on the wiki site, this can be interpreted more as allowing students to have the ability to edit or maybe even create pages to add, some ideas that were pitched were creating sample quizzes or providing pages where you could post links to external sources of information. And the last bit of worthwhile feedback suggested making the wiki site more interactive; students said that it was "too boring now".

Question 19 on the survey asked students about their willingness to edit wiki pages if given the opportunity. Most students said that they would not edit the wiki. The students said that nothing needed to be edited, meaning that there were no big mistakes that could be found in content. Other students pointed out the fact if the site were to be open to editing by anyone then the validity of the site may be called into question. For the future, if editing were to be allowed by people who access the site, it might be beneficial to have someone checking the site for correct information, like a TA or lab instructor. Question 20 asked the students what they expected to receive as a grade in the BB2903 lab. Most students answered A or B. This question could be used as a comparison to grades received in past years, to see if the wiki site had any influence on the student's performance. The last question asked students to give any comments or suggestions they had for the wiki site. There were only a few comments received, the ones that pertains to the wiki site were generally good. Students agreed that the site was helpful. Changes to the site could be made if more directed questions were asked about more specific parts of the site. Leaving the comments section too open did not result in constructive suggestions for changes. Overall the feedback could be considered positive because there were no comments about changing any big aspect of the wiki site.

Our group sought to create a medium for sharing the available information for the BB2903 Lab Course with students enrolled in the course. Based on the results, which showed 70 % of the students agreed that the Wiki site allowed greater understanding of the material taught during the course, we believe that the site successfully completed this goal. The site was clearly utilized, as over 80 % of the class visited the site at least once during the term, often more. The wiki site was most helpful while completing the prelabs, according to student responses, which indicated that 75 % of all students visited the site for that purpose. Based on comments from the student survey, as well as our own observations, there are several recommendations to make for future projects and studies. Several students presented an interest in improving the Wiki site through student editing. To aid this, several Wiki pages could be created accurately describing the correct procedure for editing and saving the Bio Wiki pages. The pages should include troubleshooting methods for different web browsers such as Firefox and Google Chrome, as well as workarounds for Macintosh computers, which can view the site material, but not edit it. Additionally, a student agreement form could be created to limit the amount of misinformation that is often created through freely editable wiki sites. Alternatively, any student wishing to create additional content for the site could approach a professor or TA who could then approve of the content to be added. Another suggestion is to expand the Wiki site

content to cover all four BB290X lab courses. The availability of the videos on the site was a positive factor for many of the students, who felt they benefitted from the visual reinforcement. Overall, this IQP project was a success and further improvements are clearly defined for future additions or changes to the BB290X Wiki Site.

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